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Middle Jurassic Ostracoda from Southern England and Northern France

by

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ABSTRACT

A taxonomic and biostratigraphic study of Middle Jurassic (mainly Bathonian) ostracods from southern England and northern France is here presented. A fauna of 111 species of 55 genera, belonging to the Order Podocopida, is described. Thirty four species, 3 genera, Strictocythere, Angliaecytheridea and Konarocythereis and 1 subgenus, Blanoacanthocythere, are new; a further 11 species are left under open nomenclature owing to lack of material.

The biostratigraphic application of the ostracods is a continuation of the work of Bate (1978) in constructing a zonation scheme based on ostracods for the correlation of the English Bathonian. Such a zonation is necessary because of the rarity, and often absence, of ammonites within the Stage and because of the highly complex interfingering of facies belts, making correlation on lithologies very tenuous. The Zones are named, fully defined and applied to a much wider geographical area than before. These are the rimosa, confossa, polonica, blakeana, and falcata Zones, the lowermost rimosa Zone (commencing in the topmost Bajocian) being subdivided into the rimosa, batei, and postangusta Subzones. Considered as time Zones they are shown to be highly reliable in dating sediments of varying facies and to permit a direct correlation of the beds in southern England with those of northern France. On the basis of the zonation two lithostratigraphic units in the French succession, the Calcaire de Reviers and the Caillasse de Fontaine-Henry are no longer considered valid as discrete units and are regarded as being equivalent to the Calcaire de Blainville and the Caillasse de Blainville respectively.

Certain discrepancies in the ostracod faunas are seen between the areas sampled and these are used to construct a slightly modified palaeogeographic interpretation to that currently accepted.

Acknowledgements

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CHAPTER 1

Introduction

This thesis has the deliberately broad title "Middle Jurassic Ostracoda from southern England and northern France" in order to encompass a number of parallel studies. By far the major part of the thesis concentrates upon two aspects of research. First, it deals with the taxonomic study of the ostracods; second, it deals with the biostratigraphy of the ostracod-bearing beds and, as such, is the first micropalaeontological study to examine, and consequently compare, Middle Jurassic strata both north and south of the English Channel. Although many workers have published accounts of Middle Jurassic ostracods, these have been generally either localised studies based on single quarries or sequences of sections within the same geographic area, or they have been comparative studies over a much larger area either within Britain or within France. By merely perusing the photographic plates of many of these papers it is evident that many faunal elements in the English and French assemblages are common to both, but the precise extent of the similarity, the degree of diversity and possible causes of the faunal differences have not been studied. This thesis attempts to fill this gap in our knowledge of Jurassic micropalaeontology.

The Bathonian Stage was chosen for this study because of the wealth of material available (both in the form of borehole material and as excellent outcrop exposures) and, as will be seen later, because of the need for a correlation tool other than those normally adopted.

The second aspect of research, therefore, is the biostratigraphic application of the ostracods under study. It is well known that the Jurassic System is excellently subdivided by a succession of ammonite zones (for the M. Jurassic ammonite zonation see Torrens, 1965, 1969 and Parsons, 1974, 1977), although the scarcity of ammonites in much of the Bajocian and Bathonian rocks of Britain and France has made correlation of the varied lithologies very tenuous. Consequently, as evidence of the problem, "the last stage in the English Jurassic to yield to ammonite zoning, the Bathonian, has only lately been reduced to order, chiefly by mapping" (Arkell, 1956). The Geological Survey has, over the last twenty years or so, systematically mapped large areas of the Bathonian outcrop in southern England and their resultant stratigraphic classification does not correspond with the ammonite synthesis mentioned above (Penn, An Alternative, Interim, Bathonian Correlation Chart, in press). The complex interfingering of facies belts over relatively short distances, particularly in southern England but also to a lesser extent in Normandy, makes mapping of such beds extremely arduous, and Arkell's statement not, therefore, entirely satisfactory. Ideally what is required is some facies-independent component within the sediments which can be used as a basis for correlation, not only locally but over very wide areas. Such a correlation would therefore be free of the largely subjective interpretation resulting from field mapping alone. This thesis offers the ostracods as an alternative means of correlation. The groundwork for an ostracod-based correlation was carried out by Bate in 1978 when he introduced an ostracod zonation of several numbered zones based largely on the type section of the Stage in the Bath district. This thesis attempts to trace these zones east into Kent and Boulonnais and south into Normandy, testing at the same time the validity of the zones.

Ostracods occur in freshwater, brackish and marine environments and consequently in a variety of lithologies. Although some are facies-controlled, others are very definitely facies-independent and it is these which are used as the basis of the zonation scheme. The greater part of the Bathonian sediments were marginal marine where the advantage of using ostracods over purely marine ammonites is obvious. In 1858 Albert Oppel, the father of zonal stratigraphy, wrote "The difficulty (of constructing an adequate zonal table) arises chiefly from the insufficient number of well-described species. The more accurately the species are defined the more exactly can the beds be subdivided" (Die Juraformation). He referred, of course, to ammonites but the statement applies equally well to ostracods. It bears out admirably the need for an accurate and comprehensive study of the fauna from beds at different geographic locations before a reliable correlation of those beds may be made. The taxonomic part of this thesis is therefore of intrinsic importance in the appreciation of the stratigraphical use of the ostracods.

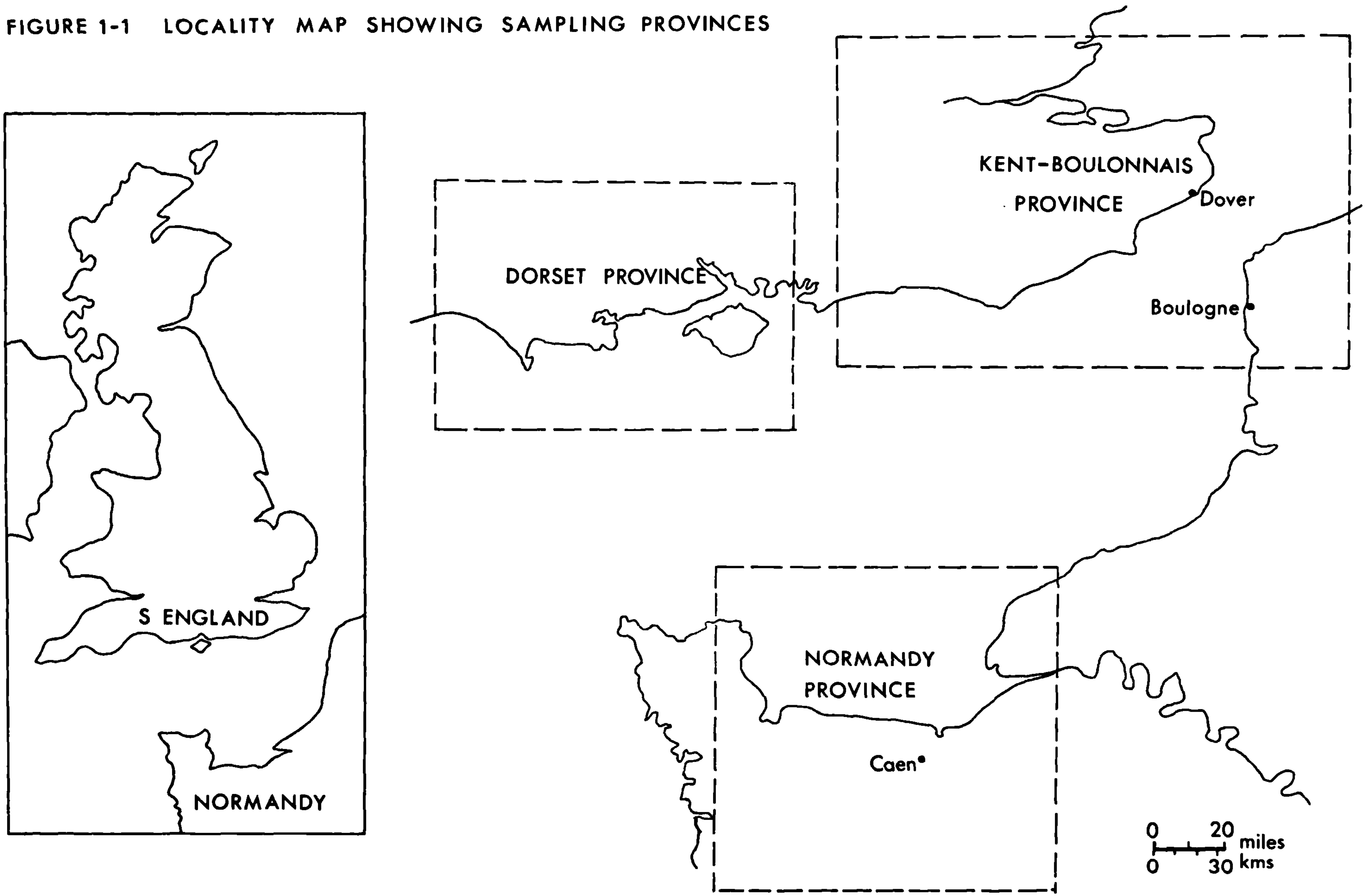
In addition to the above studies, consideration has also been given to the ecology of the ostracods, their distribution and how this relates to the palaeogeographic interpretations. Possible evolutionary trends are also discussed.

The areas of study fall into three well defined regions which, for convenience, I have termed 'provinces'. These are the Dorset Province, the Kent-Boulonnais Province and the Normandy Province (fig. 1-1). It is interesting to note how the similarity of beds in the Bathonian north and south of the Channel belies the fact that they contain quite different macrofossil faunas. Palmer (1974) has shown that, for example in the Great Oolite of southern England, bivalves are the most abundant single taxon, many of which are infaunal burrowers, while in the equivalent beds in Normandy epifaunal species are the more abundant e.g. sponges, worms, brachiopods, bivalves and echinoderms. The ostracod fauna similarly shows subtle differences between the Dorset and Normandy Provinces and these are explained in terms of palaeogeography and dispersal patterns.

1-1 Dorset Province

This includes the counties of Dorset, Hampshire and southern Somerset. The thickest development of Bathonian sediments occurs here. The outcrop runs approximately north-south in the western part of the area and extends south into the Channel for a short distance before it disappears under a cover of younger sediments. The stage reaches a thickness of almost 400 m near the coast, but in the north of the area, at Frome, it thins out radically to only about 70 m. This northern boundary to the province marks the position of the Mendip Axis, a 'positive' region which profoundly influenced sedimentation during the L. Jurassic and early Bajocian. North of the province, deposition of the L. Bathonian at successive levels was uniform, however, from the Fuller's Earth Rock period onwards the beds thin out markedly southwards suggesting that the 'Axis' became a dominating feature again after deposition of the L. Fuller's Earth (Penn et al. 1979). Similarly, internal thinning of much of the Middle and Upper Bathonian sediments is observed within the Dorset Province, north to Frome, where even brief pauses in sedimentation are evidenced by the

FIGURE 1-1 LOCALITY MAP SHOWING SAMPLING PROVINCES



intercalation of limestone bands, many of which are porcellanous and burrowed.

Material examined from the Dorset Province was entirely subsurface in origin from four of the more recently drilled Geological Survey boreholes; three onshore boreholes at Seabarn Farm, Winterborne Kingston and Frome, and one offshore one in Lyme Bay. The locations of these boreholes are shown in fig. 1-2. The sediments in this area are an essentially argillaceous sequence of clays and mudstones with a capping of shelly limestones. From all four borehole sections, a very rich and diversified ostracod fauna was recovered.

1-2 Kent-Boulonnais Province

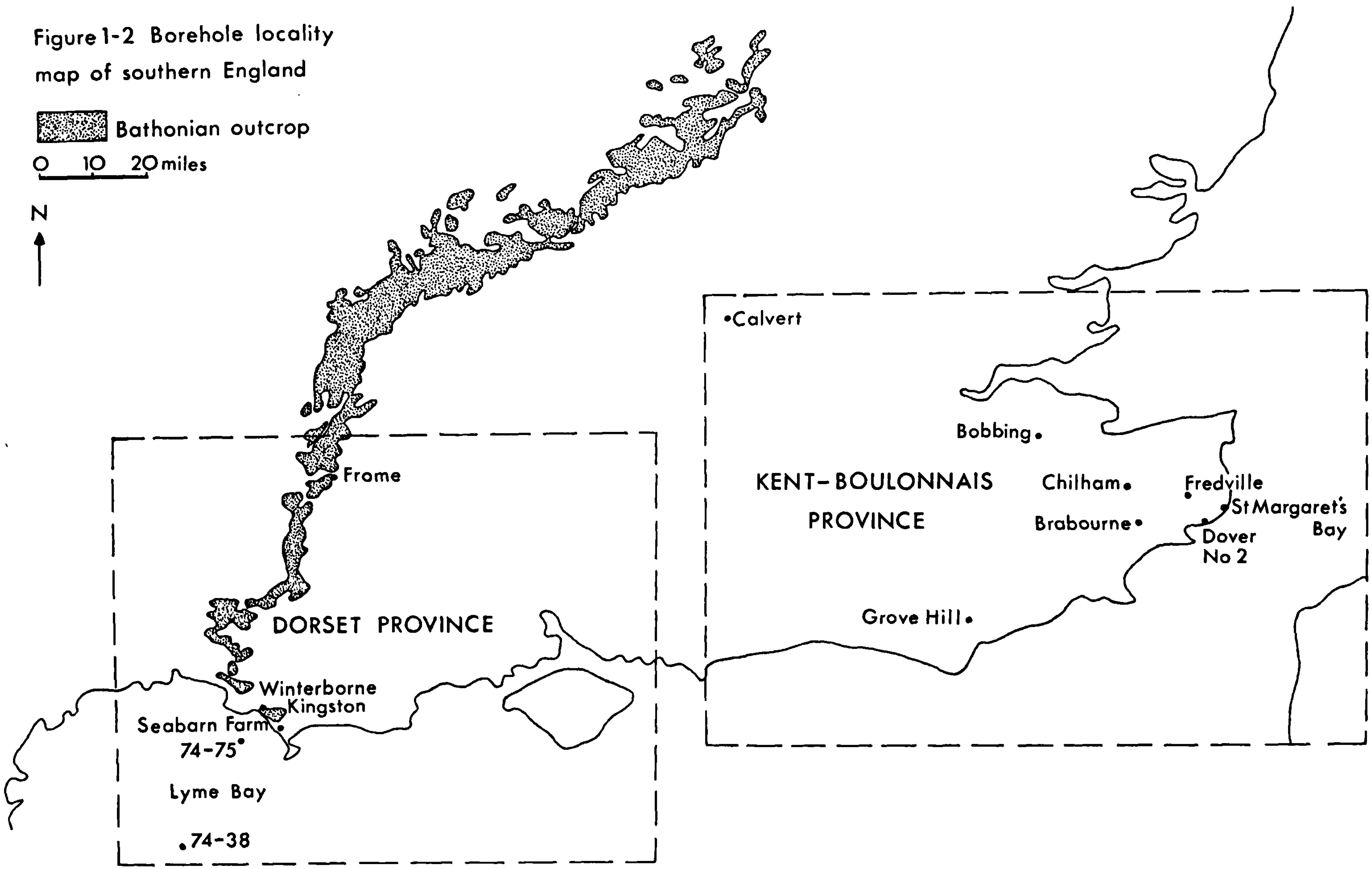
The largest of the three provinces, this encompasses Buckinghamshire, Surrey, Sussex, Kent and Essex and, on the opposite side of the Channel, Boulonnais. The Bathonian outcrops in Boulonnais but in south east England it is concealed under a Cretaceous and Tertiary cover, where it thins to the north and north east as it oversteps underlying strata to rest on Palaeozoic basement. The entire Bathonian is very much thinner than in the Dorset Province, reaching a maximum thickness of about 40 m. The sediments are much harder, consolidated limestones with a higher proportion of arenaceous components. Lower and middle Bathonian ostracods are very poorly represented but the Upper Bathonian Forest Marble and, to a lesser extent, Lower Cornbrash yielded very rich faunas.

Again, subsurface material was made available for this study from eight boreholes drilled at about the turn of the century or just later, by British Petroleum (formerly the D'Arcy Exploration Company) and now housed with the Geological Survey. Six of these are of the original coal-exploration borings: Bobbing, Chilham, Brabourne, Fredville, St. Margaret's Bay and Dover. The Calvert and Grove Hill boreholes are slightly later drillings carried out for stratigraphic purposes. The Boulonnais samples were collected at surface outcrop by myself and Dr Ray Bate during early summer of 1979.

1-3 Normandy Province

The Bathonian Stage reaches a thickness of 140 m here (Dangeard,

Figure 1-2 Borehole locality map of southern England



1951, Arkell, 1956). In the west of the area, around the classic cliff section of Port-en-Bessin, the lower part of the sequence is a series of clays and mudstones lithologically very similar to those of Dorset. Around Caen and along the coast further east, these beds pass laterally and vertically into limestones with subordinate beds of highly fossiliferous clays, marls and rubbly limestones. The Upper Bathonian Limestones form a wide plateau over this northern area (Calvados) which is thinly covered by late Tertiary and Quaternary sands. The plateau has consequently been dissected by several rivers flowing north into the Channel. It is in the banks of these rivers e.g. the Orne, that many of the studied sections occur.

South of the town of Caen, around Falaise, the Lower Bathonian is absent and the Middle and Upper Bathonian lie directly on top of Lower Palaeozoic basement.

The topmost part of the Bajocian was also sampled, from the type locality of the stage at Bayeaux in order to establish the position of the lower limit of the basal Bathonian ostracod zone. In all, 18 sections were sampled; quarries, cliff sections and road cuttings during early summers of 1978 and 1979 by myself and Dr Ray Bate.

CHAPTER 2

Middle Jurassic Geology

2-1 Stratigraphy

The complex variation of rock-types, numerous non-sequences, minor erosion levels and abundant fossils at many horizons have made the Jurassic System one of intense study by many generations of geologists, from as early as 1799 when William Smith first proposed his "Table of the Order of Strata and their embedded Organic Remains in the vicinity of Bath, examined and proved prior to 1799". Smith was one of the earliest workers to realise the importance of fossils and noted that the "same strata were found always in the same order of superposition and contained the same peculiar fossils". A major contribution to Jurassic stratigraphy was made by the French geologist Alcide d'Orbigny who, in the years 1842-9, introduced 10 stages of the Jurassic. These were based, not on lithology but on assemblages of fossils which he considered to be "delineated by nature with bold strokes across the whole earth". Although the idea of stages was somewhat exploited (by 1888 Mayer-Eymar had introduced no less than 30 such stage names) the idea of dividing Jurassic strata into subdivisions based on fossil content was a vital step towards our present knowledge of Jurassic stratigraphy.

2-1-1 Southern England

The area around the town of Bath, therefore, afforded one of the first major areas of study of the Jurassic sediments which were soon to take the name of the town becoming the Bathonian Stage. Lithostratigraphic terms such as the Inferior Oolite and the Great Oolite were in common usage by the early nineteenth century. The term 'Great Oolite Series' was originally applied to the entire Bathonian and was believed to consist of 3 successive formations: a clay, the 'Fuller's Earth'; a limestone containing the notable developments of oolites, the 'Great Oolite', and the shelly limestones with interbedded clays, the 'Forest Marble'. Two problems arose from this classification. Firstly, the oolitic limestones of Bath are not present south of the Mendips so here the entire succession below the Forest Marble was referred to as Fuller's Earth, and secondly it was not certain whether or not the local representatives of the Great Oolite, even in the limestone successions of the Cotswolds to the east, were capable of time correlation throughout southern England. The first problem, the sudden disappearance of the Great Oolite Limestones south of Bath, was termed by Arkell (1933) 'the master problem of Great Oolite stratigraphy'. The precise relationship between the limestones of Bath and the clay-mudstone sequences of S. Somerset and Dorset has given rise to much speculation and various correlations have been put forward (e.g. Green and Donovan, 1969). Work by the Geological Survey, however, has done much to clarify the situation by the study of borehole sections in the vicinity of the transition area (e.g. Winterborne Kingston). The lithostratigraphic classification adopted here follows that which resulted from the work of the Geological Survey (Penn and Wyatt, 1979), and comprises a three-fold subdivision with, in ascending order, the Fuller's Earth Series itself divided into three (the Lower Fuller's Earth, Fuller's Earth Rock and Upper Fuller's Earth); the sequence of clays and mudstones representing the southern equivalent of the Great Oolite, termed the Frome Clay, and finally the Forest Marble and Lower Cornbrash (see Table 2-1). The boueti Bed at the base of the Forest Marble in Dorset is taken as the equivalent of the 'Bradford Clay' shell bed at the base of the Upper Rags, lowermost Forest Marble, in the Bath area. The wattonensis Beds at the base of the Frome Clay are regarded as the southerly equivalent of the 'smithi' limestones of Bath.

Division of the Bathonian in south-east England is not quite so clear owing to the difficulties of correlating, largely on lithologies alone, between borehole sections and because of the minor non-sequences. The Fuller's Earth Series is largely undivided and in many of the sections is absent. Hard white oolitic limestones of the Great Oolite make up the bulk of the succession and these are overlain, over the entire area, by limestones and clays of typical Forest Marble aspect, often with typical faunas. Bradford Clay faunal elements occur and, if the incoming of this is as reliable an index here as it appears to be at outcrop in Bath, then this can be taken as a good indicator of the base of the Forest Marble. Lower Cornbrash occurs to the north around London but towards the south coast,

Table 2-1

Lithostratigraphic classification of the Bathonian sediments in southern England.

DORSET PROVINCE		KENT-BOULONNAIS PROVINCE
L.Cornbrash		L.Cornbrash
Forest Marble *boueti* Bed		Forest Marble
Frome Clay *wattonensis* Beds		Great Oolite
Fuller's Earth Series	Upper Fuller's Earth	Fuller's Earth Series
	Fuller's Earth Rock	
	Lower Fuller's Earth	?

Table 2-2

Ammonite zonation scheme for the Bathonian.

STAGE		AMMONITE ZONE		FORMATION	
				DORSET PROVINCE	KENT-BOULONNAIS PROVINCE
Bathonian	Upper	discus	discus	L.Cornbrash	L.Cornbrash
			hollandi	Forest Marble	Forest Marble
		aspidoides		Frome Clay	Great Oolite
		hodsoni		Upper Fuller's Earth	Fuller's Earth
	Lower M.	morrisi subcontractus progracilis		Fuller's Earth Rock	?
		zigzag		Lower Fuller's Earth	

around Grove Hill, is absent and is presumed to have been completely removed (Penn, in press).

The lower limit of the Bathonian is presently recognised by the appearance of ammonites of the zigzag Zone, the upper limit falling within the Cornbrash at the junction of the Lower and Upper Cornbrash having been traced by Douglas and Arkell (1928, 1932) across the majority of southern England. Table 2-2 shows the currently accepted ammonite zonation scheme. Not all the boundaries can be drawn in with certainty owing to scarcity of index species at many horizons. The main problematical areas lies in the progracilis, subcontractus, morrisi and hodsoni Zones. The M. Bathonian progracilis Zone was originally proposed for the fauna of the Stonesfield Slate in the Cotswolds which is not represented in southern England. It has been placed within the M. Bathonian on account of the occurrence of rare Clydoniceras and Tulites species within the fauna (Arkell, 1951-1959, p.20). The M. Bathonian morrisi and subcontractus Zones both occur within the Fuller's Earth Rock (above the progracilis Zone) and cannot be separated. Furthermore, they have been shown to be strictly facies-controlled (Torrens, 1971) and therefore of little stratigraphic value. The U. Bathonian hodsoni Zone is the more restricted equivalent of the retrocostatum Zone or 'unnamed' Zone of Torrens (see Torrens 1965, 1971) which is in fact characterised by the absence of certain genera and species occurring in the Zones above and below rather than by any characteristic assemblage of the Zone itself. The Zone is thought to include the wattonesis Beds of the Frome Clay and the Upper Fuller's Earth.

Fig. 2-1 shows simplified vertical profiles of each borehole section examined in southern England and the Bathonian succession at each one. It demonstrates well the drastic thinning of the Stage eastwards towards Kent and also the internal thinning towards the Mendip Axis at Frome. The borehole locations are seen on fig. 1-2.

2-1-2 Normandy

As in southern England, the difficulties of correlation of the Bathonian in Normandy arise not from erosions and transgressions as in the underlying Inferior Oolite but from the lack of ammonites and the

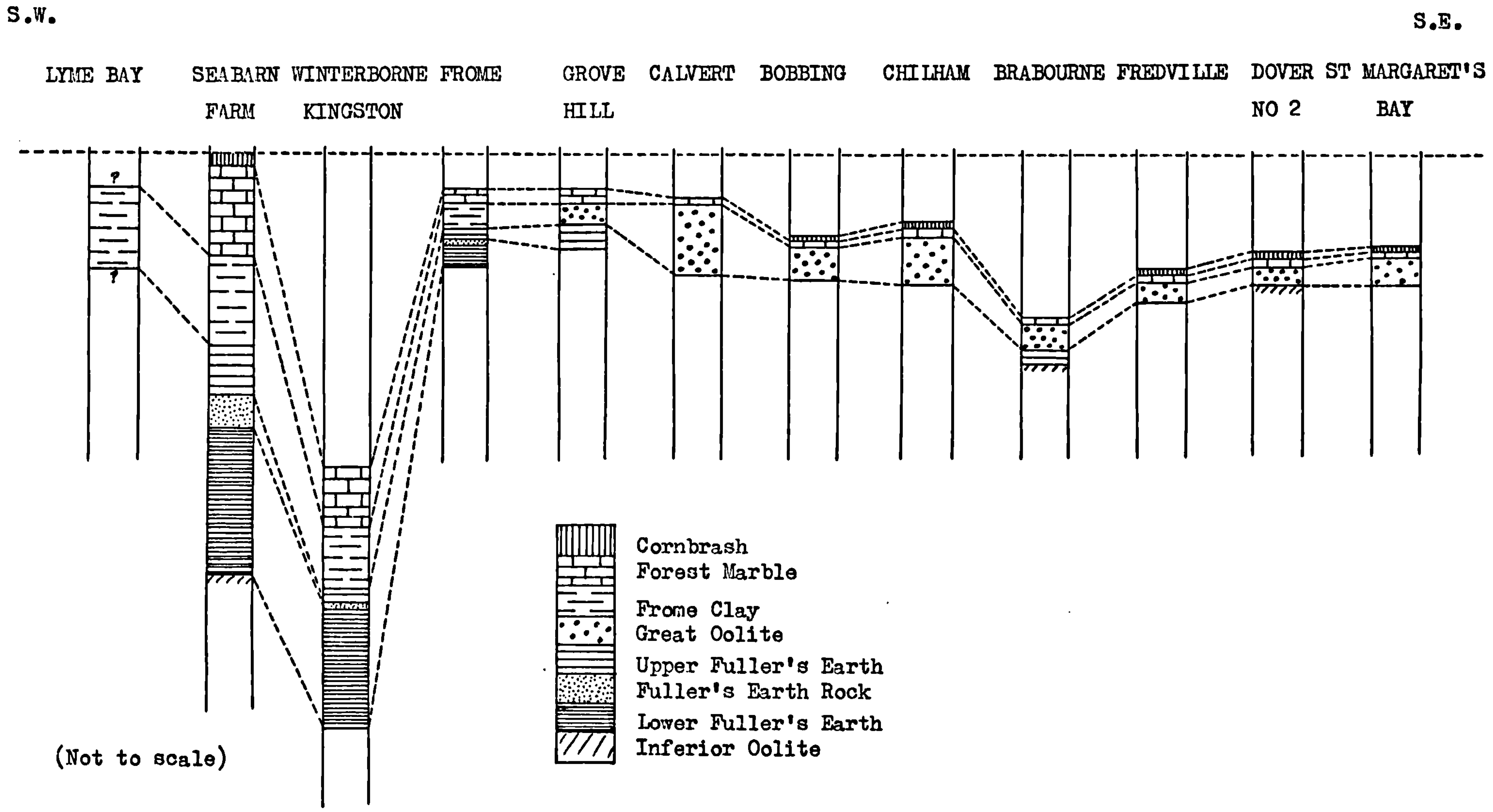


Figure 2-1 Vertical profiles of the borehole sections in Southern England demonstrating the marked thinning of sediments towards the London-Brabant Massif in the East.

bewildering variation of local facies. These complex lithologies over relatively short distances have resulted in a whole host of local names and quarrymens terms. Quarried freestone, for example, was usually given the name of the village nearby so that the same bed elsewhere will therefore have a different name. In the English language there are three major accounts of the Bathonian of Normandy: Arkell, 1930, 1956 and Bigot, 1930. Numerous French workers have worked in the area, however and a comprehensive bibliography of these works is given in Arkell (1956, p652-655). Caen University was the centre of most of this research during the years 1925-1950 but unfortunately the excellent and extensive palaeontological collections housed there were destroyed during the liberation of Caen in July 1944. The older workers who have contributed most to the Bathonian stratigraphy in Normandy are Bigot, Guillaume, Mercier, Parent and Dangeard. More recently Fily (1974, 1978) and Palmer (1974, 1979) have contributed much to the sedimentology and stratigraphy of these sediments.

As ammonites are nowhere common in Normandy brachiopods have been used in the past as a tool for correlation, the two most important being Rhynconella (Goniorhynchia) boueti and Terebratula circumdata. In England G. boueti is restricted to the horizon of the boueti Bed at the base of the Forest Marble in Dorset. Arkell correlated this bed with the horizon where G. boueti is most common in Normandy i.e. the basal part of the St. Aubin Member. Sylvester-Bradley (1957) and Torrens (1966, unpublished Ph.D. thesis, University of Leicester) however, have stated that the boueti Bed in Dorset belongs to aspidoides ammonite Zone whereas that in Normandy is discus (hollandi Subzone). T. circumdata occurs frequently within the Campagnettes Member in Normandy but has not been recorded from England. It seems likely, therefore, that the distribution of these two fossils was under ecological control.

Table 2-3 gives a general summary in table form of the stratigraphical division of the Bathonian rocks in the Calvados region from as early as 1927. The scheme adopted in this thesis follows that of Palmer (1974) for the upper part and Fily (1974, 1978) for the lower part. Palmer's terms are preferred for the U. Bathonian as they do away with

STAGE		BIGOT 1927	BIGOT 1928	GUILLAUME 1929	MERCIER 1932		PARENT 1939
BATHONIAN	UPPER	Cornbrash	Cornbrash		Argiles de la roche de Sallenelles		Argiles du Cornbrash
		Bradfordien s	Pierre blanche de Langrune & clays with brachs.& sponge reefs		Pierre blanche de Langrune		Pierre blanche de Langrune
		Caillasse de Ranville	Marnes à R.boueti Caillasse sup. à amm.	Zone à R.boueti Caillasse Inf. ceph.à Ranville	Argiles à brach. Pierre de Taille de Ranville sup. Caill.à G.boueti Caill.à ceph.		Marnes a brach. Pierre de Taille de Ranville sup. Caill.à G.boueti
	MIDDLE	Pierre de Taille de Ranville	Pierre de Taille de Ranville et du Maresquet	Pierre de Taille de Ranville	Pierre de Taille inf.de Ranville		Pierre de Taille inf.de Ranville
		Caillasse de Blainville	C. de Blainville à O.aspidoides	Caillasse de Blainv.et Maresqu	Caillasse a T.circumdata		Caillasse à T.circumdata
		Calcaires a recifs de Blainville et de Colombelles	Calcaires oolithiques de Blainville et Montville	Zone des recifs et calcaires oolithiques	P.de T. de Blain. et Colom.	Caill.de Longues et Marigny	Pierre de Taille de Colombelles
				Caillasse de F-H sup. inf.	C.de FH a H.ret.	Caillasse a H.retr.	Caillasse de F-H à H.retrocostatum
				Calcaires de Creully et Reviers	P.de T. de Cre.	Calc.de Maisy	Pierre de Taille de Creully et facies oolithiques
	LOWER				Calcaire de Caen Couches de Fonte. le Marm.	C.de Criq. C.de Vier. Marnes de P.en B. C.de Pass.	Calcaire de Caen
Bajocian					Oolithe Blanche		

Table 2-3 Lithostratigraphical divisions of the Bathonian strata in the Calvados region of Normandy. . . . . contd.

STAGE		AMM. ZONE		DANGEARD 1950	RIOULT 1962	PALMER 1974	FILY 1978	THIS ACCOUNT
BATHONIAN	UPPER	discus	discus	Marnes à R. morieri de Lion		Cornbrash	Cornbrash	Cornbrash
			hollandi	Pierre blanche de Langrune	Pierre blanche de Langrune	Langrune Member	Calcaire de Langrune	Langrune Member
				M.sup.de Ranv.	M.a brach.	St. Aubin Member	Caillasse de la Basse Ecarde	St. Aubin Member
				Caillasse à R. boueti	Caillasse à R. boueti			
				C. à cephal.	C. à cephal.			
		aspidoides		Pierre de Ranville	Pierre de Ranville	Ranville Member	Calcaire de Ranville	Ranville Member
		morrisi		Caillasse à T.circumdata	C.de Blainville et de Maresqu.	Campagnettes Member	Caillasse de Blainville	Campagnettes Member
	MIDDLE	subcontractus		Pierre de Blainville	Calcaire de Blainville et de Colombelles	Blainville Member	Calcaire de Blainville	Blainville Member
				Caillasse de H.retrocostat.	Caillasse de Fontaine-Henry	Fontaine-Henry Member	C.de F-H / Calcaire de Revier-Creully	Calcaire de Caen / Marnes de P en B
				Pierre de Creully	Calcaire de Cr.et de Revier	Revier Member		
		progracilis		Calcaire de Caen	Calcaire de Caen / Marnes de Port-en-Bessin		Calcaire de Caen / Marnes de Port-en-Bessin	Passage Beds
	LOWER	zigzag						Oolithe Blanche
Bajocian								

Table 2-3. . . .contd. Lithostratigraphical divisions of the Bathonian strata in the Calvados region of Normandy.

the complicated local French names. The U. Bathonian is here considered to comprise six formational units or Members. These are, in descending order, the L. Cornbrash, Langrune Member, St. Aubin Member, Ranville Member, Campagnettes Member and Blainville Member. Two members are omitted from the succession: the Fontaine-Henry and Revier Members (see the conclusions chapter for the reasons for this). Beneath the Blainville Member the Calcaire de Caen and the top part of the Marnes de Port-en-Bessin form the rather restricted M. Bathonian; the L. Bathonian comprises the rest of the Marnes plus the Passage Beds at the base, overlying the Inferior Oolite.

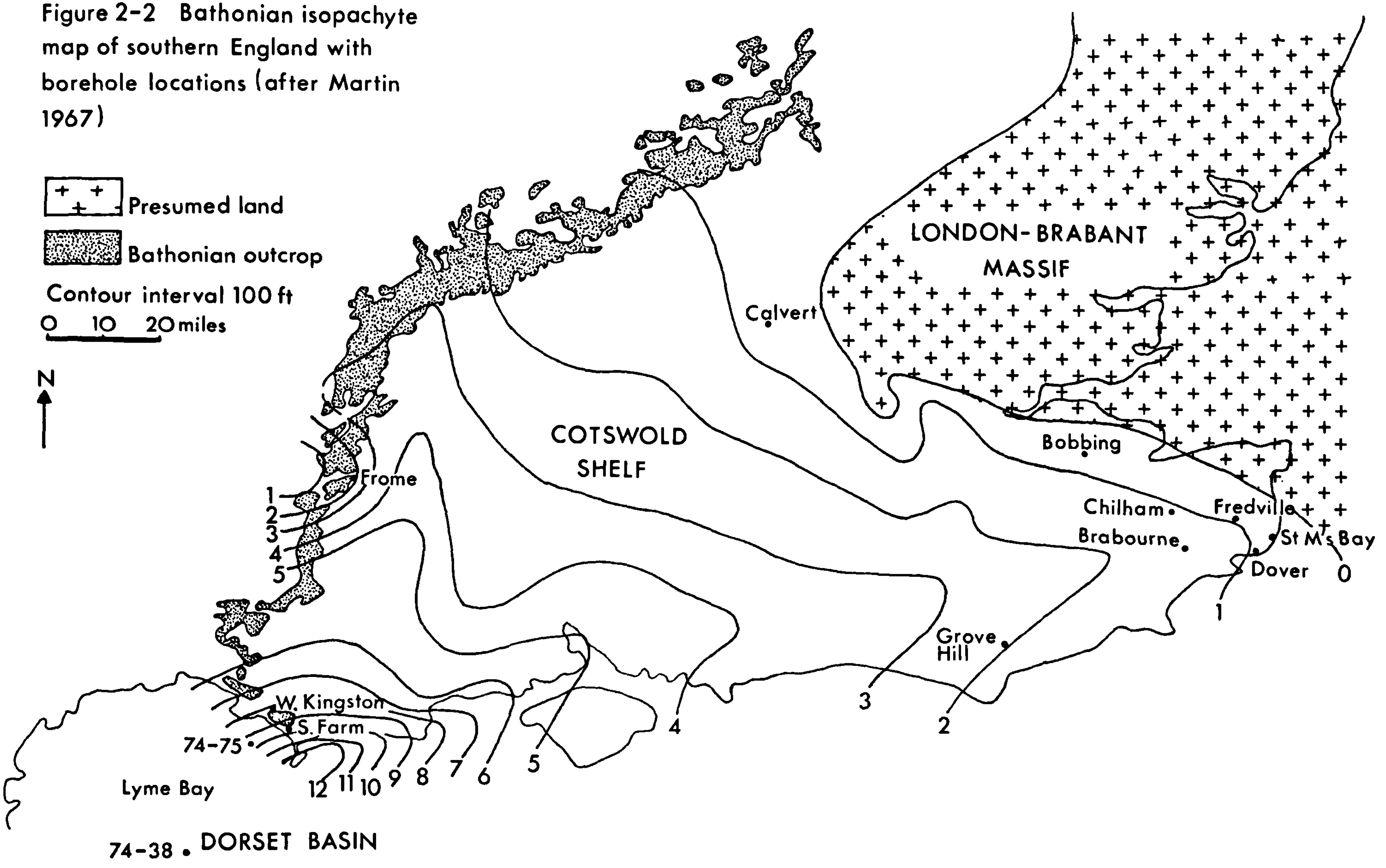
The ammonite zonation scheme for Normandy is based on Rioult (1962) and Torrens (1971). According to these workers the only Zones which can be identified with any certainty are zigzag, progracilis, aspidoides and discus. Morrisi and subcontractus ammonites occur in the 'Caillasse de Longues et de Marigny' which outcrop to the east of the area studied. These beds are thought to be equivalent to the 'Calcaire de Ranville et de Colombelles' (= Blainville Member), a judgement based on field evidence but not, however, substantiated with any ammonites. Although Prohecticoceras retrocostatum is cited many times in the French literature (see Table 2-3) it has not been recorded with any certainty from Normandy (Rioult, 1962). This zone, or the more restricted hodsoni Zone cannot, therefore, be recognised at the present time.

2-2 Palaeogeographic setting

The paleogeography and general environmental setting of NW Europe during the Jurassic is a subject which has received a great deal of attention during recent years due mainly to the discovery of oil-bearing sands in the Jurassic of the northern North Sea, the Celtic Sea and, more recently still, onshore Dorset. Palaeogeographic reconstructions for the Jurassic have been attempted by numerous workers, however, since the turn of the century. Indeed, the existence of a Palaeozoic platform beneath the Jurassic in southern England was proved by numerous borings (some of these original borings are included in this thesis) in the London area, Kent, Surrey and Sussex, which were carried out largely as a result of a paper by Godwin-Austen in 1856 who speculated the possible extension of coal basins beneath the secondary cover of Jurassic and Cretaceous deposits. The Geological Survey first demonstrated the gradual overlap of the successive members of the Jurassic onto what was termed the London Landmass (Lamplugh, 1919). It soon became apparent that this landmass represented an island during the Jurassic (Arkell, 1933) with consecutive formations thinning out as they approached a shore-line and also becoming increasingly interrupted by non-sequences as they did so. Cyclic sedimentation, which is so characteristic of the Jurassic as a whole, was first realised by Conybeare and Philips in 1822 when they introduced the term 'Tripartite Series', referring to the typical clay/sand/limestone rhythms. By 1933 geologists had concluded that the Jurassic deposits were laid down in a trough sea that spread across the British area between two major landmasses, N. Atlantis to the west and Fennoscandia to the north east (Arkell, 1933). The sea stretched from Kent and Dorset north to Yorkshire and north west via Shropshire and the Irish Sea ultimately to the Hebrides. A number of 'axes of uplift' were present in the Jurassic in England e.g. the Market Weighton, Vale of Moreton and Mendip Axes representing residual masses of former folding belts which were reactivated as Horsts.

Fig. 2-2 shows a Bathonian isopachyte map of southern England, based on that of Martin (1967). Martin has shown that the main features result from the interplay of basin and swell development which is so typical of the pattern of Jurassic deposition in Britain (Hallam, 1958). The thickest sediments are seen to have accumulated in the Dorset Basin whose axis runs NE/SW through Dorset and Hampshire. The general NE/SW trend for the axis of Bathonian accumulation is roughly concordant with, though a little to the south of, the axis of greatest Jurassic sediment accumulation in southern England (Terris & Bullerwell, 1965). Between the two major troughs seen on the map is an extensive central southern England shelf area encompassing the counties of Berkshire, Oxfordshire, Buckinghamshire and N. Hampshire. This was an extension of the landmass area, now termed the London-Brabant Massif, over which only thin sediments accumulated.

Figure 2-2 Bathonian isopachyte map of southern England with borehole locations (after Martin 1967)



Sedimentological and ecological studies by Palmer (1979) support this general palaeogeographic picture. He has shown that during deposition of the Hampen Marly Formation in Oxfordshire (which would be roughly equivalent to the Frome Clay in Dorset), the London-Brabant Massif supported a fully terrestrial flora and had a well-developed river-drainage system. These rivers discharged south west into a series of lagoons around the edge of the landmass, producing waters of fluctuating salinities. Further SW these brackish lagoons came under the influence of more marine conditions. Here, fully marine deposits were laid down which provided stable substrates for oysters and reef-building organisms, plus a whole host of associated faunas. The sediments in this region were predominantly marls.

It is now known that, due to the discoveries of vulcanicity in the northern North Sea, Britain was in a tectonic province during the Bathonian, with cyclicity of the sediments in southern England due to both shallowing in a landward direction and to major fluctuations in water depth. In the S.W. deepening of the sea bed marks the beginning of each cycle followed by shallowing as a result of sedimentation; these processes are regarded as being an expression of tectonic control. To gain a better understanding of the situation in the Bathonian it is important to consider the palaeogeography of northern Europe as a whole. Sellwood and McKerrow (1974) have shown that marine transgressions of the early Jurassic produced a shallow epeiric sea over most of northern Europe which led to the development of well-defined facies-belts. The main sources of clastic sediments were the ancient shield-areas of Greenland, eastern U.S.A. and the Scandinavian-Russian Platform, plus the exposed Palaeozoics on their flanks (Sellwood, 1972). Within this epeiric basin, numerous positive regions existed, often as small islands, but their importance as areas of clastic supply was probably minimal. The basin covered some 250,000 sq km, centering on what is now Paris (Anglo-Paris Basin) and was bounded to the west by the Armorican Massif, to the north and east by the Ardennes Massif (the London-Brabant Massif forming the northerly extension) and to the south by the Massif Central (see fig. 2-3). Sellwood and Jenkyns (1975) have postulated contemporaneous faulting of early-to-

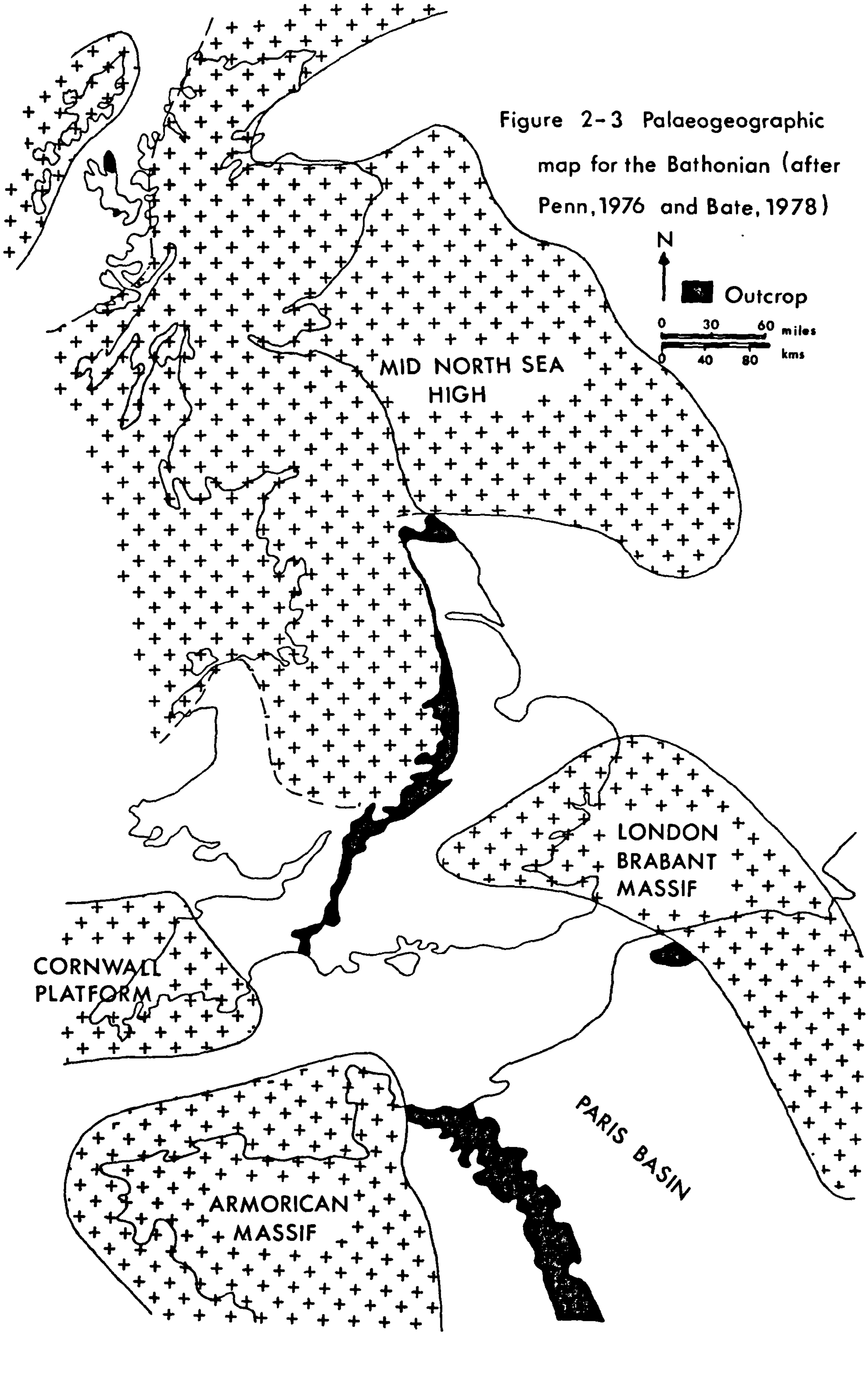


Figure 2-3 Palaeogeographic map for the Bathonian (after Penn, 1976 and Bate, 1978)

middle Jurassic strata or within the underlying basement as being the major mechanism affecting facies distribution within the Jurassic sediments in southern Britain. Arkell (1956) assumed that the Jurassic was basically a time of tectonic quiet. In the North Sea the formation of Jurassic troughs has been related by Naylor et al. (1974) and Sellwood and Hallam (1974) to rifting associated with the break-up of the Laurasian super-continent. Following this idea, Sellwood and Jenkyns (1975) believe that the whole of the north European epeiric basin owes its origin to the extensional tectonics that characterise regions marginal to new oceans, indeed comparable with the formation of the Tethyan and central Atlantic Oceans. Arkell's idea is, therefore, no longer accepted.

The most obvious consequence of the land-locked conditions of this epeiric sea is the probable reduction in the effect of diurnal tidality and therefore of tidal current activity. The Mediterranean Sea is a present-day equivalent of a shallow sea with restricted access which has virtually no tidal range. Over the Great Bahama Bank, for example, the tidal range varies from 0 to 0.78 m with no change in the water level on the middle of the bank (Bathurst, 1971). This does not, however, imply that a persistent low energy regime existed throughout Bathonian times within the Anglo-Paris Basin.

The marine environments of the Lias were replaced by fluvio-deltaic sedimentation over much of northern Britain while in central Britain fluctuations of fresh-water and marine conditions existed. In the Bathonian the open-marine shelf conditions were present only to the south and west, and the highly diverse faunal assemblages are encountered only in Normandy and further south. The overall diversity of invertebrate species in these regions was about 4 times as high as in southern central Britain (Palmer, 1979).

2-2-1 Depositional Environments of the Sediments

The broad palaeogeographic scene has been set; it now remains to deal with the sediments in turn and their respective depositional environments.

2-2-1-1 Southern England and Boulonnais

The lowest beds of the Bathonian, the Fuller's Earth Series, were deposited under subtidal, marine shelf conditions with relatively unrestricted access to the open sea to the south. Cyclic sedimentation occurred during deposition of the L. and U. Fuller's Earth with shallow-water shell beds, in which an attached epifauna was common, suggesting a stable substrate, at the base of each cycle. Gradual deepening of the sea followed with increasing sedimentation rates, decrease in grain size and a greater number of burrowing bivalves. These gradual deepening and rapid shallowing movements are thought by Penn et al. (1979) to be relatively localised and result from rapid epeirogenic uplifts followed by gradual epeirogenic downwarps in this southern England shelf region. The beds of the Fuller's Earth Rock between the L. and U. Fuller's Earth represent rather shallower conditions with a dominance of epifaunal types in the fossil assemblage and with grain size increasing upwards as shallowing continued prior to deposition of the U. Fuller's Earth. The Frome Clay is again a sequence of largely clays and mudstones representing similar depositional conditions to the Fuller's Earth Series, with occasional shell beds marking periodic shallower water conditions. The Dorset Province was probably the site of a downwarping basin during this time; indeed further S.W. it has been shown that the western English Channel was repeatedly a site of downwarping from the Trias onwards (Donovan, 1972). To the north of the study area, around Bath, the Frome Clay equivalent, the Great Oolite was deposited in a shallow water area with strong wave and current activity resulting in extensive carbonate deposition of oolite deltas and shoals. In U. Bathonian times a widespread shallowing of the sea occurred during deposition of the Forest Marble with nearness to land evidenced by sun-cracks and fresh-water influences such as plant remains. The sediments are largely fine-grained clays, often laminated with influxes of coarser terriginous material; sand-filled burrows are also present. These characteristics combine to suggest a sedimentary environment comparable to modern intertidal or subtidal flats.

Further east in Kent and Boulonnais evidence of a shoreline to the London-Brabant Massif is repeatedly seen throughout the Bathonian in the form of sandy horizons within the typically shallow water limestones (mainly oolitic) and frequent breaks in sedimentation with bored and encrusted surfaces. Charophytes are common particularly from the Forest Marble in these areas, so too are brackish water ostracods, substantiating the idea of rivers draining SW from the landmass and giving rise to lagoons here.

2-2-1-2 Normandy

The Armorican Massif which was an emergent area throughout the Bathonian is situated just to the W. of the Normandy Province. Fig. 4-2 in chapter 4 shows the probable position of the coastline of this landmass. The entire area, therefore, was relatively shallow during the Bathonian. As the beds in the north of the area appear to be different to those in the south they are dealt with separately.

2-2-1-2-1 North of Caen

Here, the lowest Bathonian beds, the Marnes de Port-en-Bessin, are lithologically very similar to the L. Fuller's Earth in southern England (not surprising, perhaps, as they both form the coastal cliffs either side of the English Channel) and were most probably similarly deposited under subtidal, marine shelf conditions. The topmost beds are sands and represent the beginnings of a marked shallowing which continues with the deposition of the Calcaire de Caen further east (the bottom part of which is age-equivalent to the upper part of the Marnes de Port-en-Bessin). Rioult (1963) has compared the Calcaire de Caen to the calcareous sands and muds which are forming today in tropical swamps, ponds and shoals of, for example, the Florida coast. These beds have yielded silicified rootlets and Rioult regards them as representing very shallow shore-line deposits. Sedimentary evidence suggests that the overlying U. Bathonian deposits represent a gradual deepening, through an environment of oolite shoals with locally developed patch-reefs, into an environment of shell sand deposition. The Members making up the U. Bathonian exhibit a pronounced cyclicity. The lowest, the Blainville Member, consists of fossiliferous, oolitic limestones, displaying good cross-bedding and deposited under shallow water conditions. Overlying this is the Campagnettes Member, essentially a sequence of soft clays and mudstones in which shell debris and whole shells are common. These deposits represent much quieter, lower energy conditions. Coarse-grained shelly cross-bedded limestones of the Ranville Member form the base of the overlying cycle, commencing again with a high-energy deposit. Within this limestone hardgrounds, suggesting periods of quieter water, are locally developed (present-day hardgrounds cannot form in agitated waters). This is overlain by the St. Aubin Member which is normally developed as a fine-grained fossiliferous limestone, generally even-bedded, in which sponge-reefs are common. The reef formation indicates relatively clear waters and the rarity of cross-bedding suggests that the currents had less influence than for either the Ranville Member below or the Langrune Member above. The Langrune Member comprises very coarse-grained friable shelly limestones with well-developed cross-bedding indicating deposition in shallow waters. The uniformity of the sediments and absence of lime-muds indicates an offshore rather than lagoonal environment.

To summarize, therefore, the U. Bathonian sediments form 3 basic cycles with the Langrune, Ranville and Blainville Members representing cross-bedded biosparites which were deposited in areas of considerable current activity. Locally, ooliths and peloids are common and in all shell fragments form a large proportion of the original sediment. Alternating with these beds are the St. Aubin and Campagnettes Members which are finer grained, contain more complete shells and represent much quieter low-energy conditions.

The overall depth changes throughout the Bathonian are probably due to changes in the configuration of the Armorican Massif shoreline to the west. The deepening represented by the more marly Members in the U. Bathonian was not, however, very great as algal evidence is present throughout these beds (Palmer, 1974) indicating that the sea-floor was permanently within the photic zone.

2-2-1-2-2 South of Caen

South of Caen the picture is somewhat different. The sequence of Members identified to the north of the city cannot be recognised here. The L. Bathonian is absent and the M. and U. Bathonian lie directly on top of the L. Palaeozoics. The abundance of ooliths and the algal activity associated with oncolites and limonitic coatings suggests a shallow water situation. Although not many locations were sampled in this area

Palmer (1974) has observed that cross-bedding is rare within the limestone which, together with the presence of ooliths, points to a quiet shallow marine area with oolite shoals and absence of strong currents. The open sea would have been situated to the north with land to the south and south-west (Bigot and Hommey in 1927 described a palaeosoil 25 km south of Villedieu as evidence of the landmass).

CHAPTER 3

History of Ostracod Studies

3-1 Southern England

The pioneering work on the Middle Jurassic Ostracoda of England was carried out by Professor T.R. Jones who, towards the end of the Nineteenth century, published two important papers on the Bathonian of southern England. The first, in 1884, described both the Ostracoda and Foraminifera of the Richmond borehole, Surrey, while the second, in 1888 jointly with C.D. Sherborn, described the ostracods of the Fuller's Earth from Midford, Bath and of the Bradford Clay from Bradford.

The next major contribution to Bathonian ostracod studies was made by P.C. Sylvester-Bradley who, in 1948, published a descriptive account of the Upper Bathonian ostracods of the boueti Bed, Langton Herring, Dorset. This work was of particular importance as Sylvester-Bradley placed a greater emphasis on the use of structural features in taxonomy higher than the species level, and led to his paper entitled 'The structure, evolution and nomenclature of the ostracod hinge' in 1956.

Work on the Bajocian and Bathonian for the past 17 years has been dominated by one key figure, R.H. Bate, who has published extensively on sediments of this age from north, central and southern England. An important revision of Jones' early work, where a large number of species were assigned to genera such as 'Cythere' and 'Cytheridea', was also carried out by Bate (1969). The drilling programme of the Geological Survey (Institute of Geological Sciences) over the past few years has made available for study a large amount of Bathonian sediments, in particular the lower part of the succession which was otherwise rather poorly represented in surface outcrop, leading to a number of recent publications.

3-2 Northern France

Contemporaneously with Jones in England, Terquem was carrying out work on the Middle Jurassic ostracod faunas of France and Poland. This material, unfortunately, has subsequently been lost and so this pioneering effort has had very little influence on modern ostracod research.

Much of our present knowledge of French Middle Jurassic ostracods is due to the work of H.J. Oertli whose original research was on the Upper Jurassic of the Paris Basin but who was later to publish important accounts of the Bathonian of Boulonnais (1957, 1959). Later, Dépêche provided the groundwork for the Bathonian ostracod studies of N.E. France and Normandy. Dépêche has recently turned her attentions to shell structure work although she and Oertli are at present undertaking further research together on the Middle Jurassic of northern France.

CHAPTER 4

Field Localities

All the field sampling localities and borehole locations used in this research project are listed below together with a brief description of the sediments and are, in the case of the French localities, illustrated by a measured section. The ostracod fauna is not described in detail as faunal lists and range-tables for the borehole sections and field localities are given in the appendix.

4-1 Southern England

The examined borehole sections are located on figs. 1-2 and 2-2.

4-1-1 Dorset Basin

The boreholes in this region have all been recently drilled by the Geological Survey solely for stratigraphic purposes.

4-1-1-1 Seabarn Farm

(Grid Ref. SY 6263 8054, Dorset)

The most recently drilled borehole (early 1978), this represents the thickest, most complete and best sampled of all the examined borehole sequences. Some 370 m of Bathonian were drilled and of this more than 200 m are Fuller's Earth Series, largely shales and calcareous mudstones with some sandstone horizons. This comprises 140 m L. Fuller's Earth, 25 m Fuller's Earth Rock equivalent and about 40 m U. Fuller's Earth. This is overlain by about 80 m of Frome Clay, which is lithologically very similar to the beds below, with the *wattonensis* Beds forming the basal 10 m or so. The overlying Forest Marble has a higher proportion of arenaceous components and attains a thickness of about 75 m, with a very thin *boueti* Bed at the base. The section is completed by about 10 m of L. and U. Cornbrash (i.e. includes basal Callovian). All 5 ostracod zones are well represented here, indeed the sediments yielded a very diverse ostracod fauna of more than 100 species.

4-1-1-2 Winterborne Kingston

(Grid Ref. Sy 8470 9790, Dorset)

Although geographically close to the preceding borehole the

Bathonian here is covered to a depth of 680 m; at Seabarn Farm the Bathonian outcrops at the surface. The Winterborne Kingston borehole was drilled in late 1976/early 1977 and just over 230 m of Bathonian were encountered. The Fuller's Earth Series comprises, as at Seabarn, argillaceous limestones and mudstones with some shell debris and grit bands; about 100 m L. Fuller's Earth, thin (about 7 m only) Fuller's Earth Rock and about 15 m U. Fuller's Earth. The Frome Clay comprises 60 m of lithologically similar beds, overlain by just over 50 m of fine-grained limestones, mudstones and occasional sandstones of the Forest Marble. This is followed directly by U. Cornbrash. Again all 5 ostracod zones are well represented although the fauna is not quite so diverse as at Seabarn (60+ species).

4-1-1-3 Lyme Bay

Several offshore wells were drilled by the Geological Survey in 1974 off the Dorset coast. The 74/35 borehole was the main well to be examined although a few samples from well 74/38 were also looked at. The Bathonian outcrops at surface here but only Frome Clay and older sediments were encountered in the wells. Very good ostracod faunas, largely of polonica Zone, are recorded here.

4-1-1-4 Frome (Gibbet Hill)

(Grid. Ref. ST 7632 4769, Somerset)

A detailed account of this borehole, drilled in 1974, has recently been published by Penn and Wyatt (1979). The Bathonian is much thinner here than to the south, due partly to the influence of the Mendip Axis on which it is situated. The total thickness of Bathonian is 70 m representing about 12 m of L. Fuller's Earth (mudstones and shell-detrital limestones), 4 m Fuller's Earth Rock (calcareous mudstones and limestones), barely 1 m of U. Fuller's Earth clays, about 30 m Frome Clay (clays and mudstones), followed by 22 m or so of limestones and clays of the Forest Marble. These sediments yielded a rich ostracod fauna.

4-1-2 Cotswold Shelf

4-1-2-1 Calvert

Sometime prior to 1911 (when the samples were registered with the Geological Survey) a borehole was put down by the D'Arcy Exploration Company near Calvert Station in Buckinghamshire. Little is known of the well except that the Bathonian is about 25 m thick, being encountered at a depth of 30 m, and is underlain directly by L. Lias. The sediments are all relatively soft; mainly clays with some sandstone and limestone towards the top of the Forest Marble (about 6 m thick). The rest is Great Oolite. Both units yielded a good ostracod fauna.

4-1-2-2 Grove Hill

There are, as yet, no published accounts of this borehole which was drilled sometime in the 1930s by the D'Arcy Exploration Company, although it is shortly to be included in detail by the Geological Survey in their Lewes Memoir. The borehole is situated on the edge of the Pevensey Anticline in Sussex. The Bathonian is very deep here, the Forest Marble not being struck until 800 m below the surface. Thicknesses are not precisely known; the sequence comprises basal Fuller's Earth Series (calcareous mudstones), Great Oolite (oolitic limestones) and Forest Marble (limestones and marls). Ostracods were obtained from the Fuller's Earth and Forest Marble.

4-1-3 Kent Coalfield

Numerous borings and shafts were sunk in Kent, in the search for coal, by several independent exploration companies commencing in the year 1897. The results of these borings were published several years later by the Geological Survey in a series of Memoirs, e.g. Lamplugh and Kitchin (1911) and Lamplugh, Kitchin and Pringle (1928). These sections were all documented in feet and inches but for conformity with the other borehole sections depths and thicknesses are here given in metres. The division into lithostratigraphic units is very basic; there is usually no subdivision of the beds beneath the Forest Marble (they are grouped together as the Great Oolite) and the Cornbrash is similarly undivided.

All the sections within this area are situated close to the position of the London-Brabant Massif coastline and are consequently much condensed in comparison to Dorset.

4-1-3-1 Bobbing (drilling completed in 1911)

Here, the entire Bathonian is about 30 m thick with approximately 3 m Cornbrash, encountered at a depth of about 350 m, 3 m Forest Marble and 25 m Great Oolite. The lithologies are similar throughout the section, largely hard oolitic limestones with softer marls and sandy horizons towards the top of the Forest Marble. Few ostracods were recovered from the Great Oolite although the Forest Marble yielded a good falcata zone fauna. The Bathonian here is underlain directly by the L. Palaeozoic basement, probably L. Silurian.

4-1-3-2 Chilham (drilling completed in 1911)

The Cornbrash was here encountered at a depth of 300 m with the Bathonian sequence slightly thicker at about 45 m. This includes 5 m Cornbrash, 3 m Forest Marble and about 37 m Great Oolite. Again this was a sequence largely of oolitic limestones becoming marly in the Forest Marble where a good ostracod fauna was obtained. A thin sequence of Lias occurs between the Bathonian and the Silurian basement.

4-1-3-3 Brabourne (drilling completed in 1898)

The Bathonian is at its deepest here, the Forest Marble being struck at a depth of some 500 m. There are about 40 m of Bathonian sediments; 4 m of Forest Marble (shales and sandstones), 30 m of Great Oolite (oolitic limestones) plus 7 m or so of possible Fuller's Earth Series. The Lias and Trias are present between this and the L. Palaeozoic basement. A very poor ostracod fauna was recovered from the lower part of the Bathonian sequence. Again the Forest Marble yielded a good falcata zone fauna.

4-1-3-4 Fredville (drilling completed prior to 1907)

The Cornbrash was here met at a depth of 400 m. About 30 m of Bathonian comprises 7 m Cornbrash, 4 m Forest Marble (limestones and clays) and about 20 m Great Oolite (oolitic limestones with some sandstones), underlain by Lias. Good ostracod faunas were obtained from both the Great Oolite and Forest Marble.

4-1-3-5 St. Margaret's Bay (drilling completed at about the turn of the century)

The Bathonian is about 300 m deep here and about 35 m thick.

About 6 m each of Cornbrash and Forest Marble (marly limestones) overlie about 18 m Great Oolite (oolitic limestones, marly towards the top). The top of the Great Oolite, the Forest Marble and the lower part of the Cornbrash all yield very good ostracod faunas.

4-1-3-6 Dover No. 2 (drilling completed in 1898)

In 1897 2 shafts were sunk in Dover. Owing to engineering difficulties the more westerly No. 1 shaft had to be abandoned after only 500 ft. Drilling then continued in the No. 2 shaft until the Coal Measures were met. The Bathonian is about 40 m thick here, occurring at a depth of 300 m. A couple of metres of Cornbrash overlie about 6 m Forest Marble (mainly clays) and about 30 m Great Oolite (sandy limestones and sandstones). The Forest Marble yielded a very rich ostracod fauna.

4-2 Normandy

The Normandy localities are shown in fig. 4-2. The information presented here is intended to be comprehensive enough for further investigation of these sites by other workers. For this reason those localities which proved to be barren of ostracods and therefore of no immediate use to this study, are only briefly mentioned here. Sketch maps and measured sections are included only where ostracods were recovered from the sections. The sketch maps, showing the position of each quarry etc. in relation to its nearest town or village, are not drawn precisely to scale but 1 cm can be taken to be roughly equivalent to 1 km.

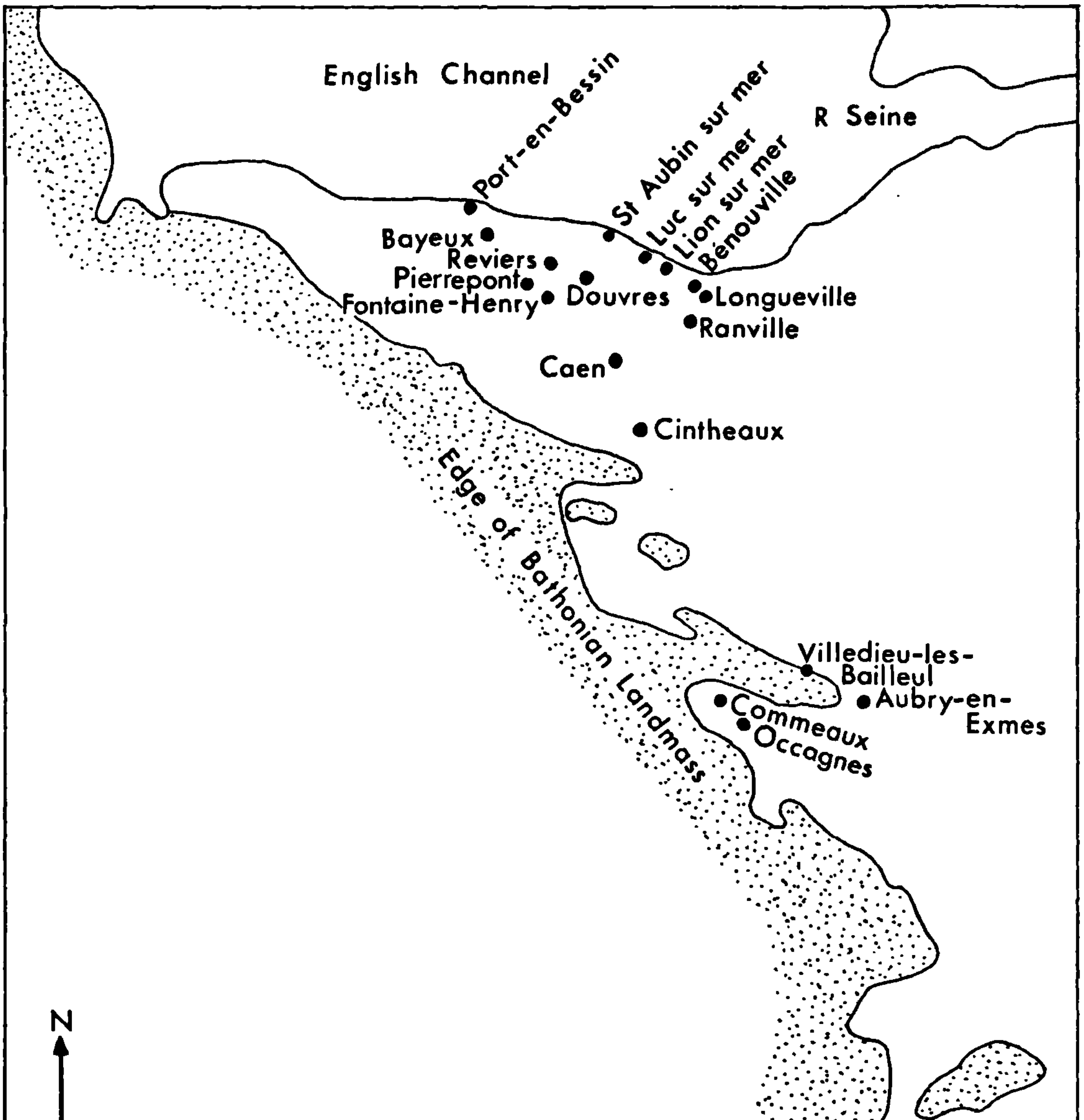
4-2-1 Sections north of Caen

4-2-1-1 Bayeux.

(Arkell, 1930, 1956)

At Sully, a small village about 2 km N.E. of Bayeux, is exposed the type-section of the Bajocian Stage. At least 2 small quarries may be seen within ploughed fields just to the W of the D6. The quarries are extremely overgrown and it is unlikely that the beds will be exposed for many more years unless drastic steps are taken to clean the section. The U. Bajocian 'Oolithe Blanche' was sampled in situ (fig. 4-3), but the highly condensed M. Bajocian 'Oolithe Ferrugineuse' is no longer visible in the quarries and this was sampled from the brash on the

Figure 4-2



Sketch-map showing the Middle Jurassic sampling localities in Normandy and the position of the Bathonian Landmass (after Walter 1969)

SULLY, BAYEUX

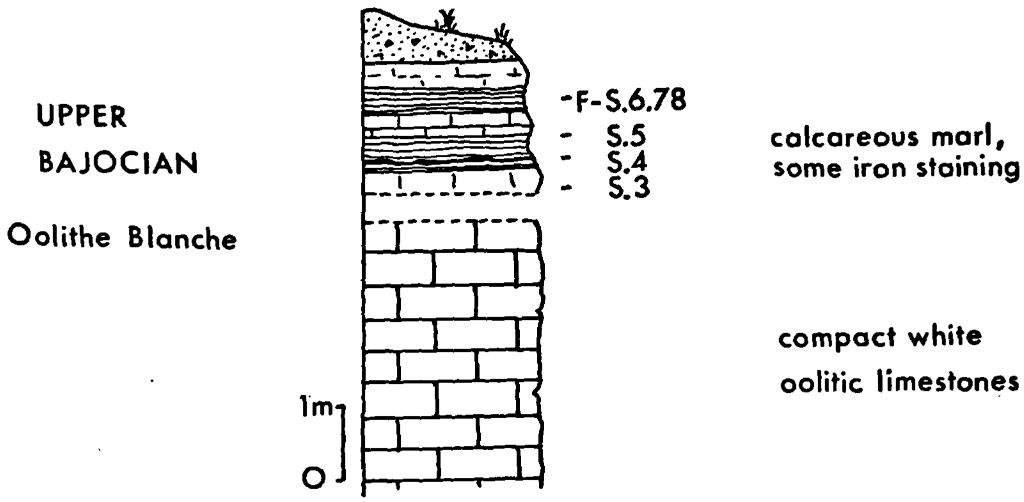
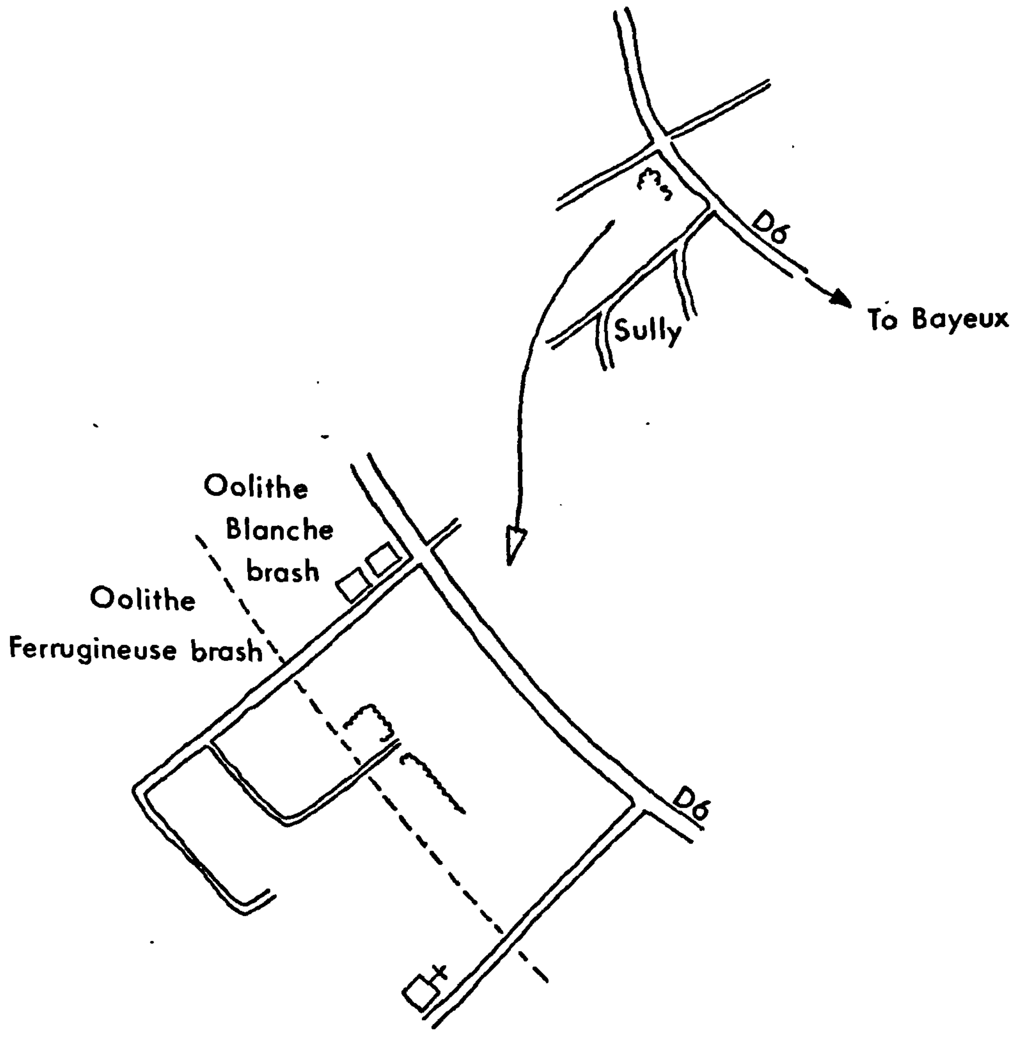


FIG. 4-3



surrounding fields. This highly fossiliferous brash yielded abundant ammonite fragments and these were processed for ostracods. The ostracod fauna was, however, disappointing from both ends. A further section of 'Oolithe Blanche' was sampled about 1.5 km N.E. of Bayeux, E. of the D 516 near St Vigor-ie-Grand. Here, a disused quarry within a field yielded about 5 m of hard white oolitic limestones of the 'Oolithe Blanche'.

4-2-1-2 Port-en-Bessin

(Arkell, 1930, Mercier, 1932, Walter, 1969, Dépêche, 1973)

The cliffs here comprise about 4 m of Bajocian 'Oolithe Blanche' overlain by a very thick (about 50 m) succession of L. and M. Bathonian clays and calcareous mudstones with, at the base, 3 distinct Passage Beds marking the base of the Bathonian. This section is seen for a few km W of Bessin and at St Honorine slumping and faulting has brought the L. Bathonian down to beach level. It also continues E. of Bessin as far as Arromanches and beyond before eventually being replaced by a section of U. Bathonian limestones. Figs. 4-4 and 4-5 show the Bessin section which, in its entirety, was closely sampled. The actual measured section and sampling levels are included in the appendix. An extremely rich ostracod fauna was obtained from these sediments, a small part of which has previously been recorded by Dépêche (1973). Capping the section is a M. Bathonian sandstone, termed the 'Grès du Planet' (Mercier, 1932). In the sequence beneath this barren bed the two ostracod zones rimosa and confossa are represented with rimosa's 3 subzones, rimosa, batei and postangusta, easily identifiable.

4-2-1-3 St Aubin-sur-mer

(Mercier, 1930, 1931, Walter, 1969, Palmer, 1974, 1979)

The low cliffs here expose the topmost part of the Ranville Member and the sponge-reef facies of the St Aubin Member (fig. 4-6). The hard fossiliferous Ranville Member limestones terminate in a hardground and are overlain by compact limestones passing upwards into rubbly limestones, followed by softer marls with abundant brachiopods and dendroid bryozoans, and finally about 4 m of highly fossiliferous limestones with sponge-reefs. Both members yielded good U. Bathonian falcata zone ostracods.

Figure 4-4 The cliffs at Port-en-Bessin showing the Marnes de Port-en-Bessin overlying the Bajocian Oolithe Blanche.

Figure 4-5 Close-up of the lower part of the Marnes, with the three Passage Beds and the topmost Oolithe Blanche.

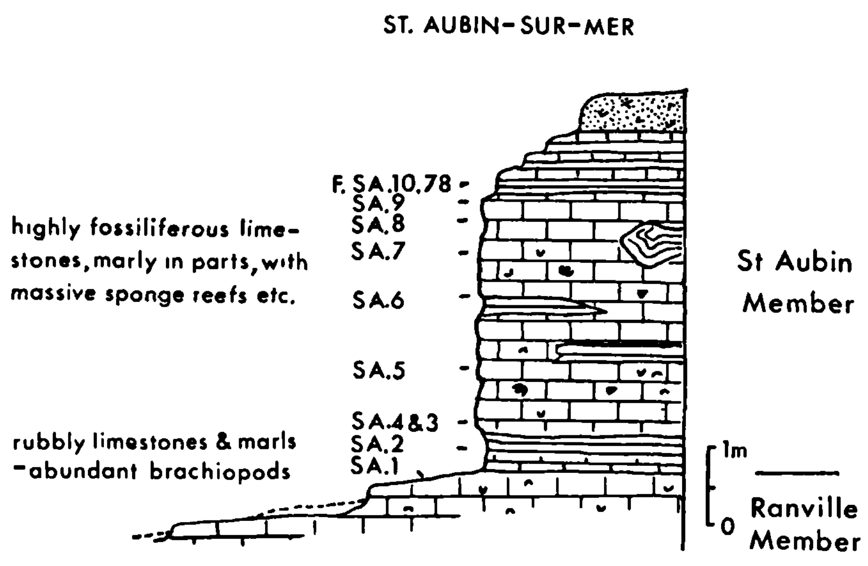
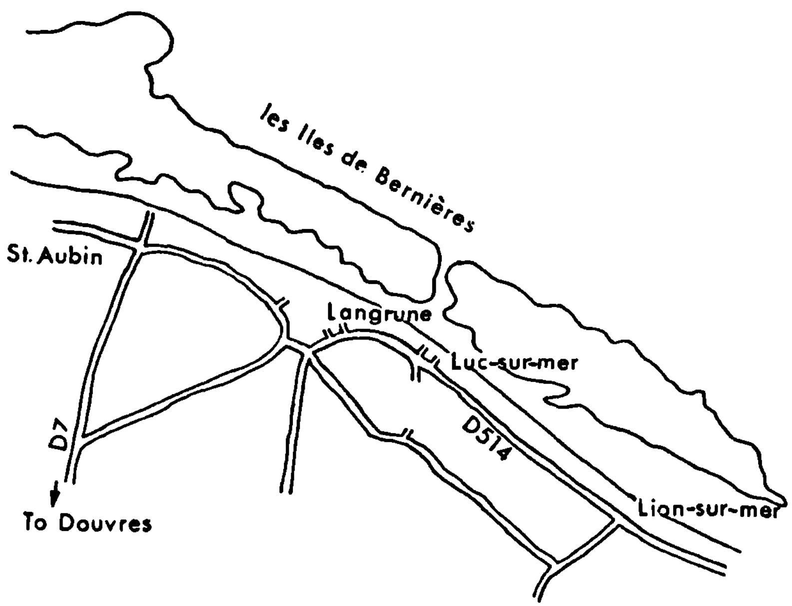


FIG.4-6



UPPER BATHONIAN

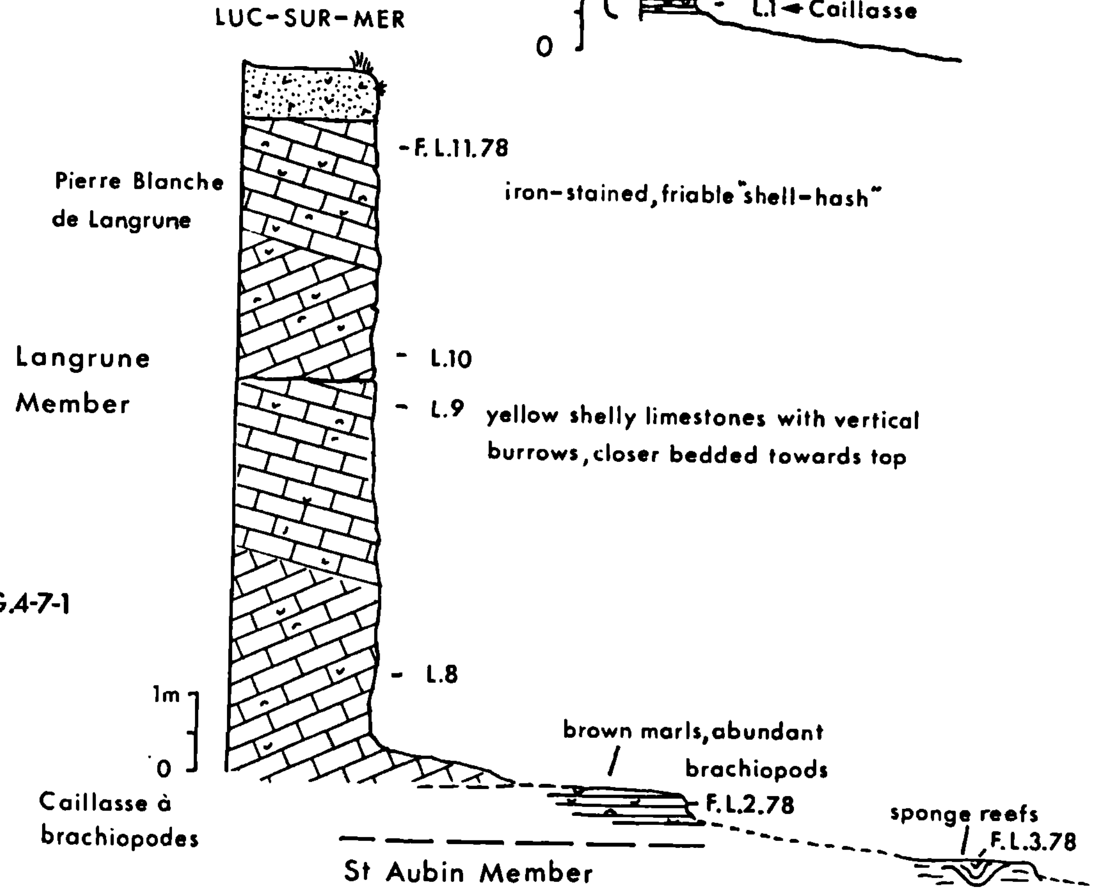
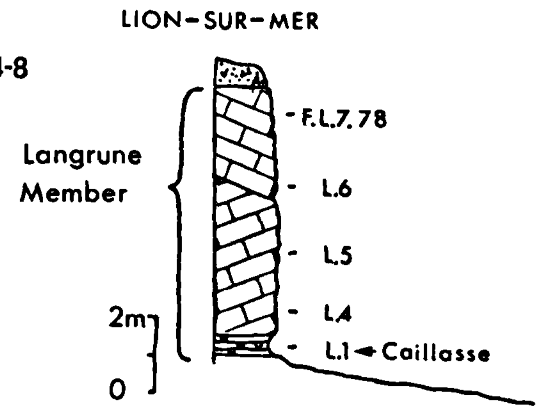


FIG.4-7-1

FIG.4-8



4-2-1-4 Coast between Lion and Luc-sur-mer

(Walter, 1969, Palmer, 1974)

A line of low cliffs, 4-8 m high, between the two Towns exposes the coarse-grained friable shelly limestones of the Langrune Member ('Pierre Blanche de Langrune'). The western part of the section at Luc exposes a hardground at the base of the cliffs overlain by 50 cm fossil lumachelle ('Caillasse à brachiopodes') which is seen in the wave-cut notch. To the E., towards Lion, this bed occurs further down, on the actual foreshore. This caillasse is composed of large algal-coated shell fragments or oncolites, set in a marl matrix. Along the entire section of coast sponge-reefs can be observed on the beach underlying the caillasse. The section is shown in figs. 4-7 and 4-8. The sediments yielded a rich U. Bathonian ostracod fauna.

4-2-1-5 Bénouville

(Palmer, 1974)

The exposures here consist of a partly overgrown quarry face on the W. bank of the Caen Canal, running parallel to the canal, S. of Pegasus Bridge, and a small clean exposure by the steps leading to the yachting clubhouse. Hard resistant cream limestones of the U. Bathonian Ranville Member are terminated in a hardground and overlain by fossiliferous calcareous marls of the St Aubin Member (fig. 4-9). A very good falcata zone fauna was recovered from this section, particularly from the St Aubin Member marls.

4-2-1-6 Longueville

To the N. of Ranville a small track leading down to a farm, W. of the D 514, exposes a small section of U. Bathonian Langrune Member. The coarse-grained friable shell hash is identical to that exposed on the coast at Luc but is fresher here (fig. 4-10). Again the ostracods proved abundant.

4-2-1-7 Amfreville

(Bigot, 1928, Palmer, 1974)

This section lies approximately 1 km N.E. of the previous section where limestones of the St Aubin and Ranville Members have actively been quarried. Two quarries were sampled here, the first exposing cross-bedded shelly oolitic limestones of the Langrune Member (as at Longueville)

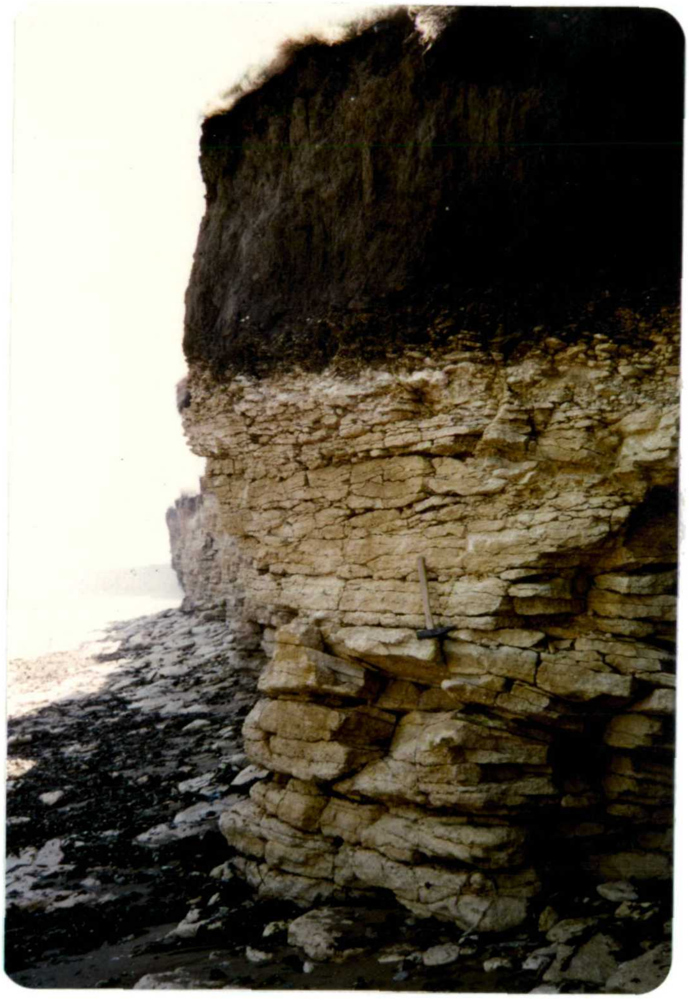


Figure 4-7-2 The cliffs at Luc-sur-mer exposing the Upper Bathonian friable shelly limestones of the Langrune Member.

BENOUVILLE

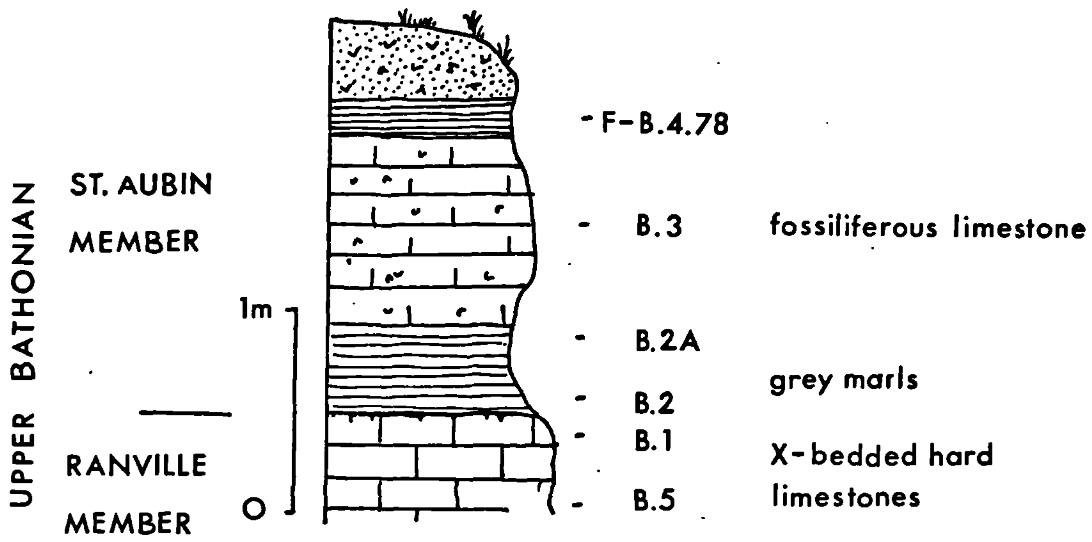
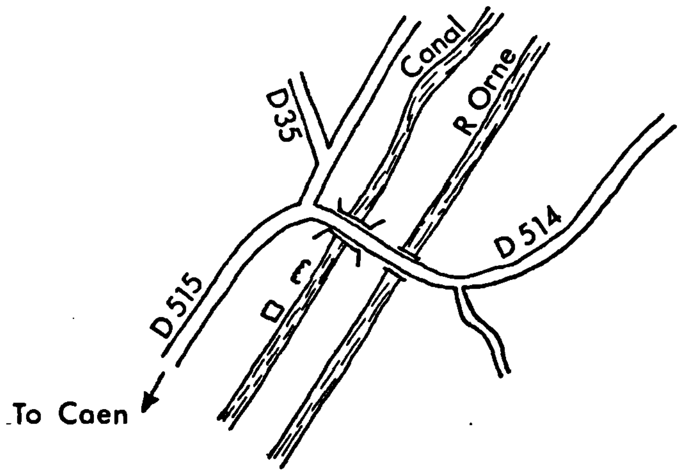


FIG. 4-9



in a shallow excavation adjacent to the D 514. The second much larger quarry further W. towards the R. Orne exposes a good clean section of some 10 m of St Aubin Member limestones (fig. 4-11). Although this quarry is now disused it is apparent that it is frequently used as a giant furnace as evidenced by the abundant charred plant remains. Good ostracod faunas were obtained from all three Members, in particular from the St Aubin Member which yielded approximately twice as many genera as the Ranville Member.

4-2-1-8 Fontaine-Henry

(Palmer, 1974)

This overgrown quarry situated in a dense wood just outside the village of the left of the D 141 to Colomby-sur-Thaon comprises about 11 m hard cross-bedded limestones of the Blainville Member, overlain by rubbly marly limestones of the Campagnettes Member (fig. 4-12). These beds were previously assigned to the M. Bathonian 'Calcaire de Reviers' and Caillasse de Fontaine-Henry by Fily, 1978. Though not rich, the ostracod fauna is typically U. Bathonian (see the Conclusions chapter for details of this revised dating of the sediments).

4-2-1-9 Douvres-la-Delivrande

(Palmer, 1974)

This large quarry, situated N. of the village just W. of the D 83, was being used (until 1978 at least) as a rubbish dump. It is completely fenced off along the N. and E. sides but can be approached from the S. along a narrow lane. Typical U. Bathonian Langrune Member cross-bedded limestones are exposed here (fig. 4-13). About 3 m from the base is a narrow band of slightly softer marly material directly overlying a conspicuous hardground with abundant encrusting *Exogyra* oysters. A reasonably good ostracod fauna was obtained.

4-2-1-10 Reviers

(Guillaume, 1929, Palmer, 1974, Taylor, 1977, Fily, 1978)

Two large disused quarries, W. of Reviers, S. of the D 176 expose beds originally assigned by Palmer (1974) to the M. Bathonian but later (see Taylor, 1977, p. xiii, 1978, p. 387) to the U. Bathonian. The ostracods recovered from this section are certainly in agreement with the later

FIG. 4-10

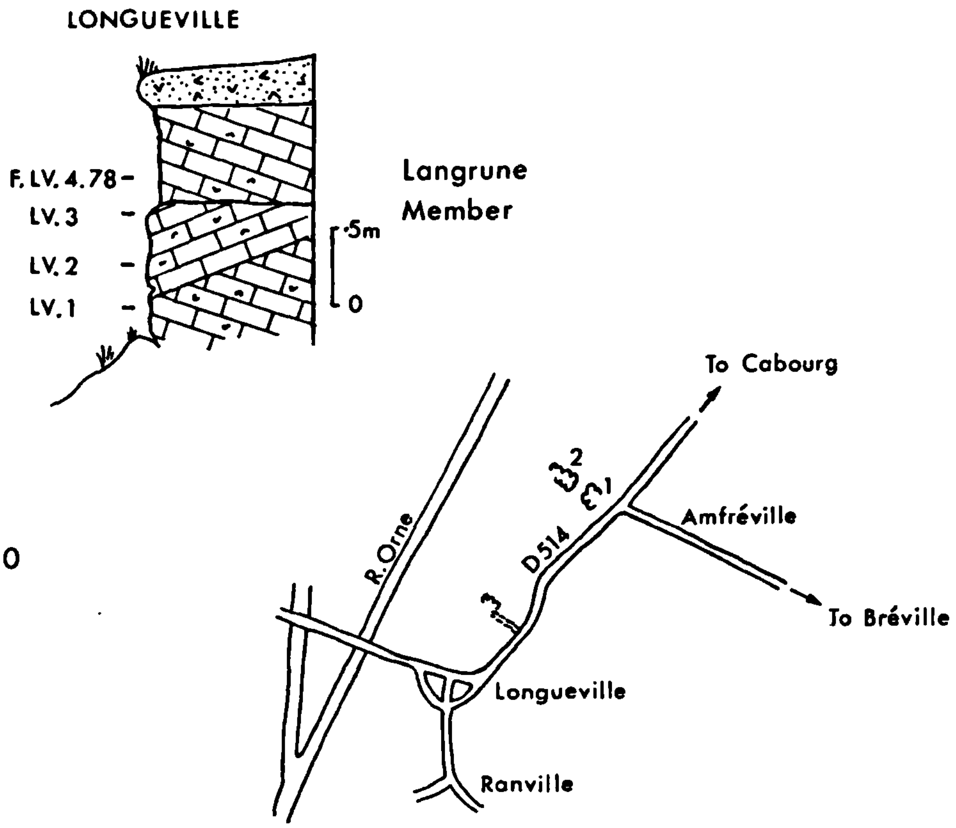
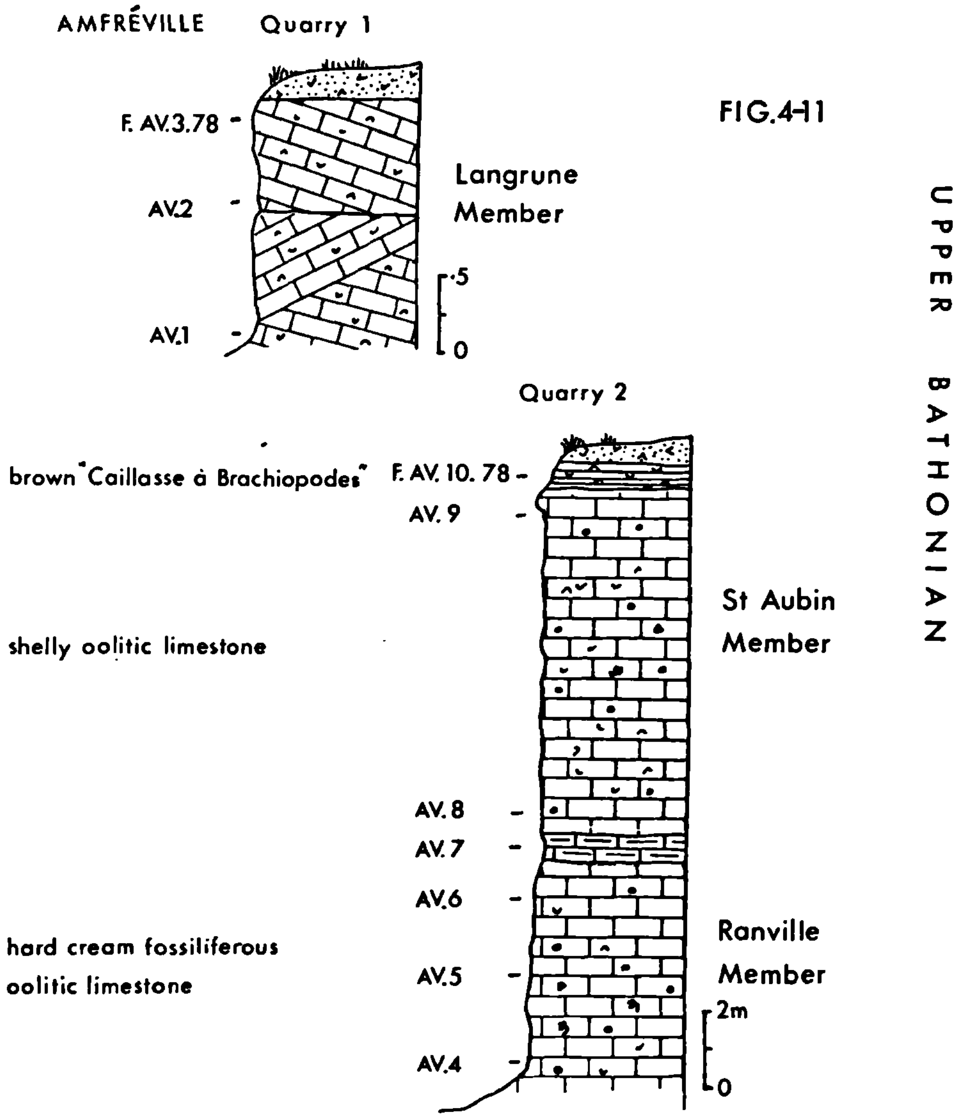


FIG. 4-11



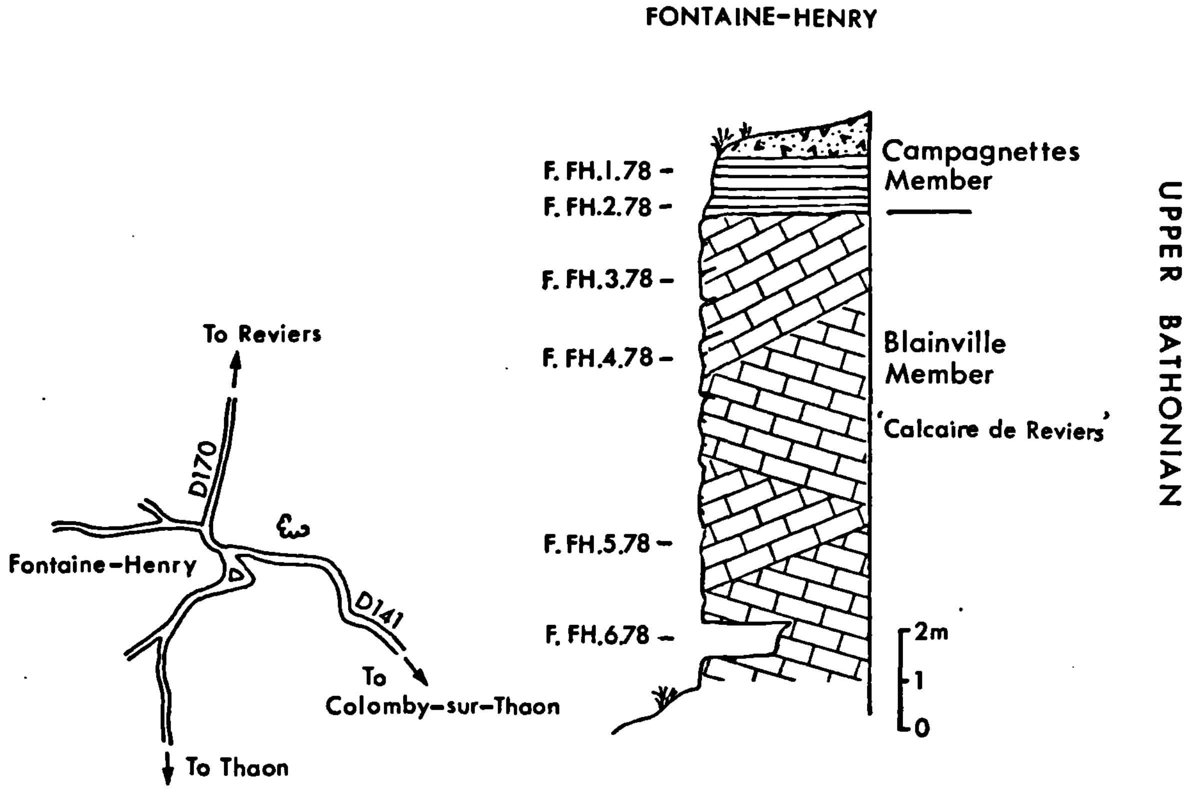


FIG.4-12

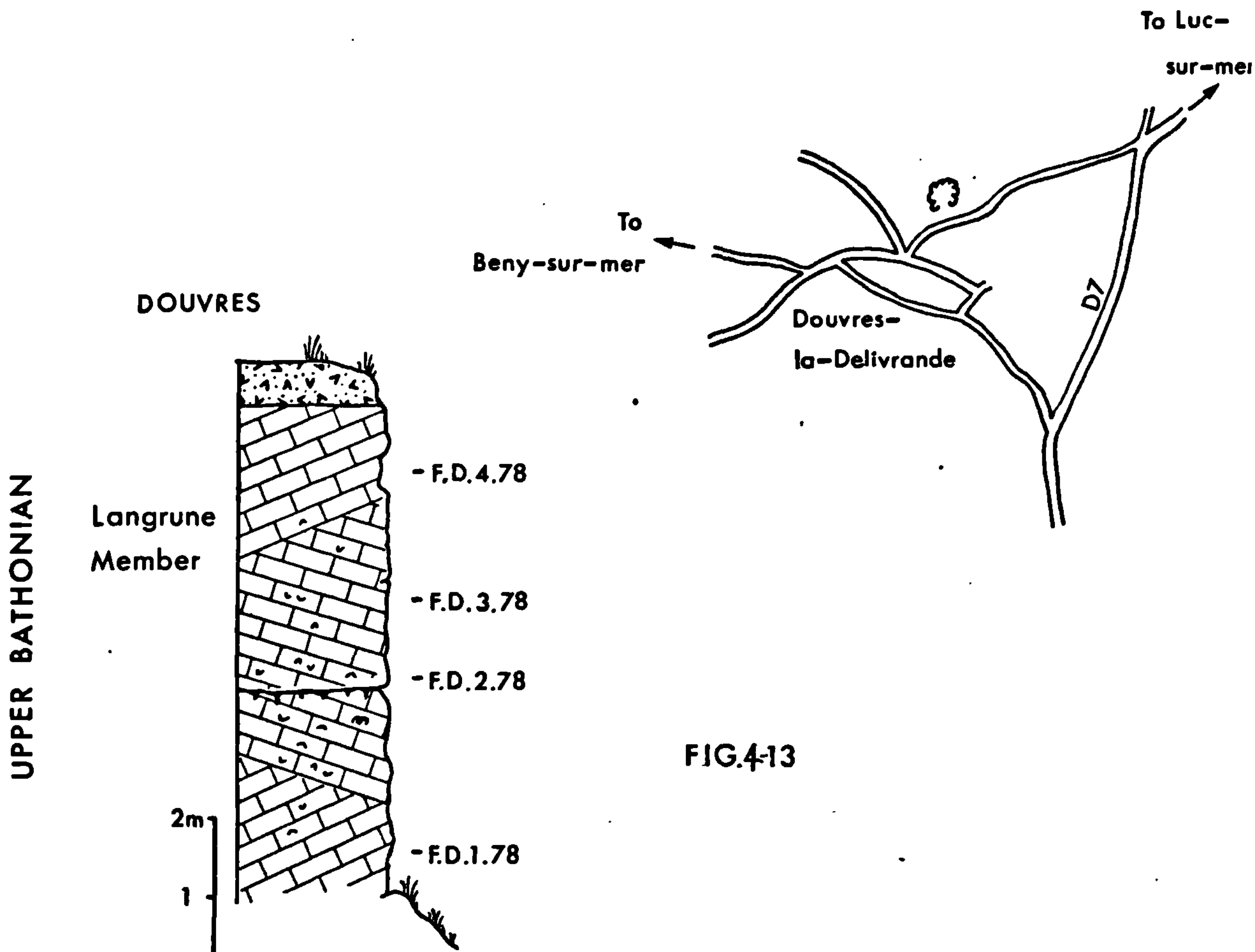


FIG.4-13

decision. The section comprises basal Ranville Member cross-bedded limestones overlain by fossiliferous soft marls with distinct sponge-masses of the St Aubin Member (fig. 4-14). Between these probable reefs, oysters, small sponges and bryozoans are common. The 2 ostracod zones, falcata overlying blakeana correspond to the 2 Members.

4-2-1-11 Pierrepont-Carrières d'Orival

(Fily, 1978)

A huge working quarry about 2 km W. of Pierrepont, N. of the D 22 exposes about 8 m of massive white unfossiliferous oolitic limestones displaying very good cross-bedding (fig. 4-15-2), overlain by about 2 m of thinly bedded friable marly limestones (fig. 4-15-1). According to Fily (1978, p.55) the cross-bedded limestone is M. Bathonian 'Calcaire de Reviers' (Revier Member of Palmer). This lithostratigraphic unit has, in addition to Fily, been recorded in Normandy by Guillaume (1927, 1929), Mercier (1932), Parent (1939), Rioult (1962) and Palmer (1974). As no diagnostic ammonities have been found within this limestone (Bigot, 1962) the ostracod data represents the first convincing evidence on which to date the sediment. The fauna obtained is U. Bathonian polonica zone which corresponds to that of the 'Calcaire de Blainville' or Blainville Member e.g. at Ranville. Lithologically these 2 units both comprise coarse-grained cross-bedded limestones, probably laid down under strong current activity. The ostracod evidence implies these deposits to be contemporaneous and one and the same. The beds at Pierrepont are therefore here regarded as U. Bathonian Blainville Member.

4-2-1-12 Caen

The L./M. Bathonian building stone 'Caen Stone' or 'Calcaire de Caen' was sampled extensively in old disused quarries to the W. and N. of Caen. About 7 m of very fine-grained yellow/cream unfossiliferous limestones are exposed, with frequent distinct interbedded chert bands a few centimetres thick. Unfortunately every sample collected was barren of ostracods.

4-2-1-13 Ranville - Cement Works

(Palmer, 1974)

This massive working quarry, known as the 'Carriere de Ciments Français' is situated S. of Ranville just to the E. of the R. Orne. Here are

REVIERS

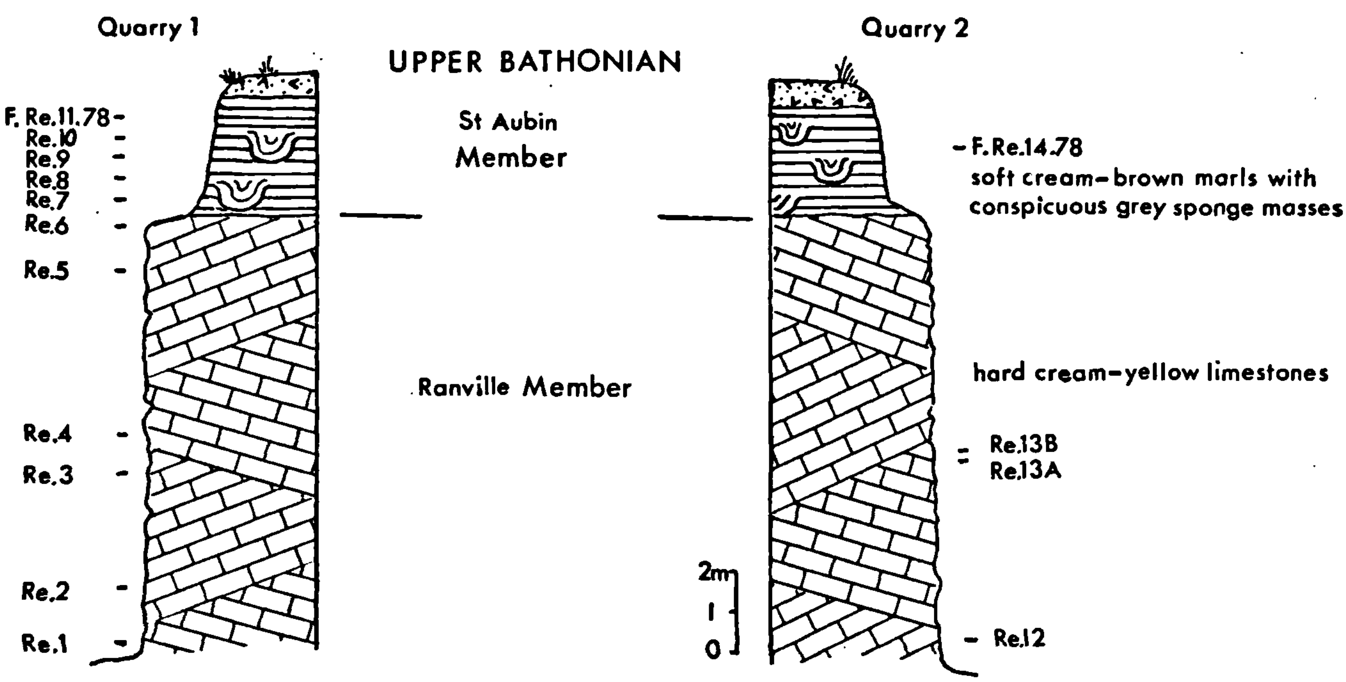
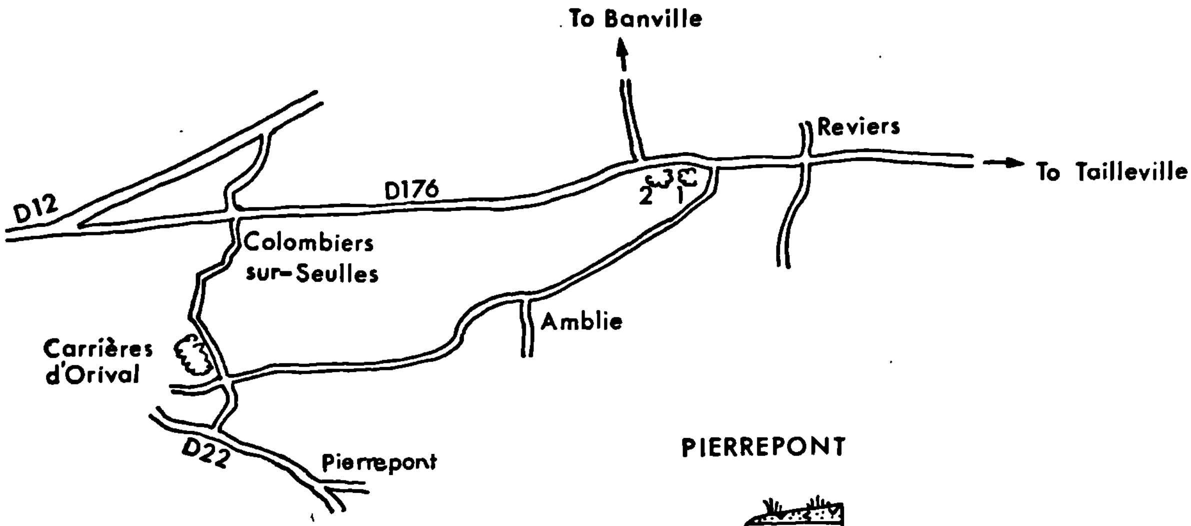


FIG.4-14



PIERREPONT

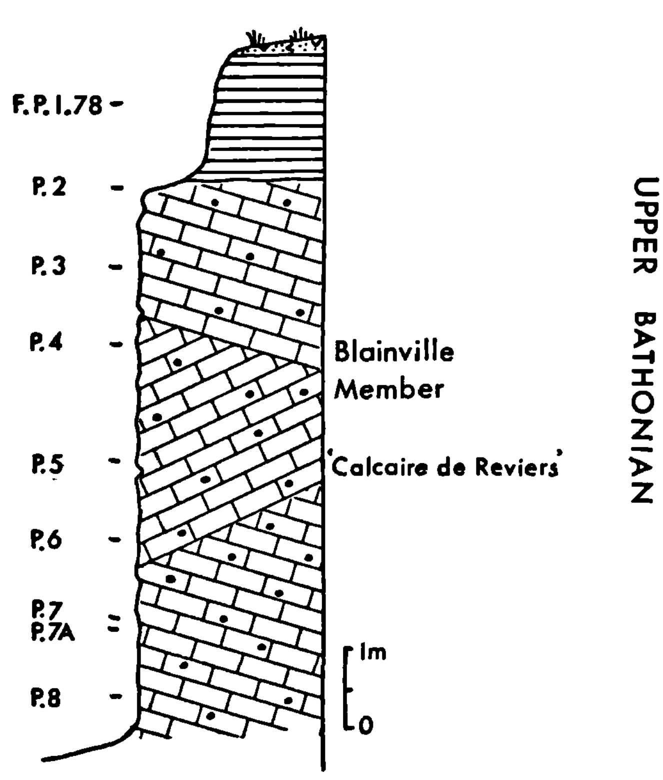


FIG.4-15-1

Figure 4-15-2 Good cross-bedding exhibited by the Upper Bathonian unfossiliferous oolitic limestones of the Blainville Member at Pierrepont.

exposed about 7 m of cross-bedded fossiliferous limestones of the U. Bathonian Blainville Member overlain by a couple of metres of fossiliferous clays and mudstones of the Campagnettes Member. This is in turn overlain by about 6 m of coarse-grained shelly cross-bedded limestones of the Ranville Member (fig. 4-16). Ostracods were obtained from each horizon sampled; the Campagnettes Member yielded a particularly rich fauna.

4-2-1-14 Ranville - Carrière des Campagnettes

(see Guillaume, 1925, Bigot, 1928, Palmer, 1974)

This working quarry is situated N. of Ranville, to the W. of the Amfréville road. An old disused section in the E. corner of the quarry possibly represents that figured by Guillaume (1925, p. 48). The topmost beds of the 'Pierre blanche de Langrune' are no longer visible so the section now comprises a thin sequence of St. Aubin Member marly limestones overlying coarsely oolitic cross-bedded shelly limestones of the Ranville Member. A fault running W.-E. through the quarry has its downthrown beds to the S. to that in this part of the quarry lower Members of the U. Bathonian are exposed. About 9 m of massive white freestone of the Blainville Member forms the basal Member. Quarried for building stone, this biosparite yields few complete-shelled fossils but contains abundant corals, e.g. *Calamophyllia radiata* (Lamouroux). This is overlain by a couple of metres of highly fossiliferous marly limestones of the Campagnettes Member, rich in corals, sponges and *'Terebratula' circumdata*. Again very good ostracod faunas were recovered, particularly from the Campagnettes Member. Fig. 4-17 shows the section.

4-2-2 Sections south of Caen

4-2-2-1 Cintheaux - Carrière des Aucrais

To the south of the village, on the main N 158 to Falaise are situated two very large working quarries either side of the road with an adjoining tunnel beneath the road. About 25 m of massive fine-grained poorly fossiliferous cream limestones, most probably the 'Calcaire de Caen', are exposed with a thin capping of oolitic limestones and clay (fig. 4-18). At the base of the section several distinct discontinuous dark grey chert

RANVILLE – CEMENT WORKS

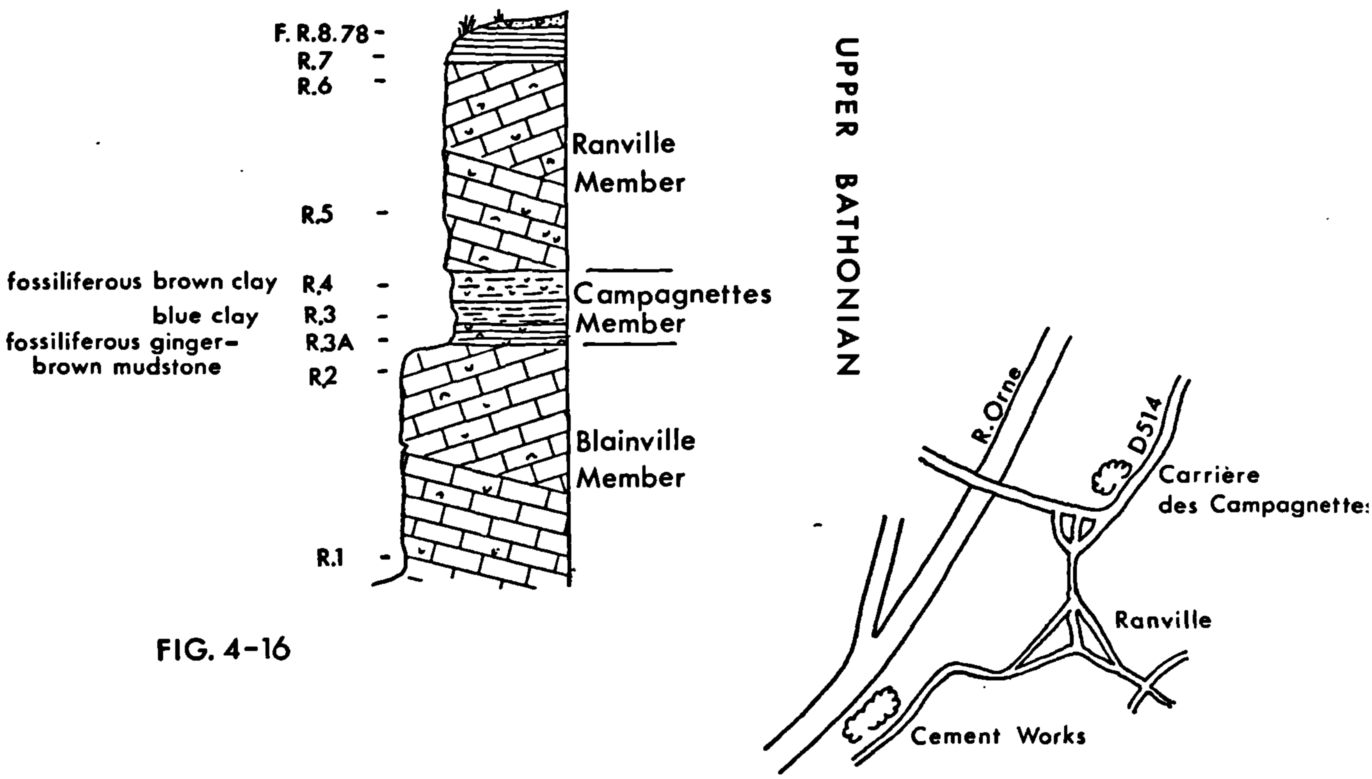


FIG. 4-16

RANVILLE – CARRIÈRE DES CAMPAGNETTES

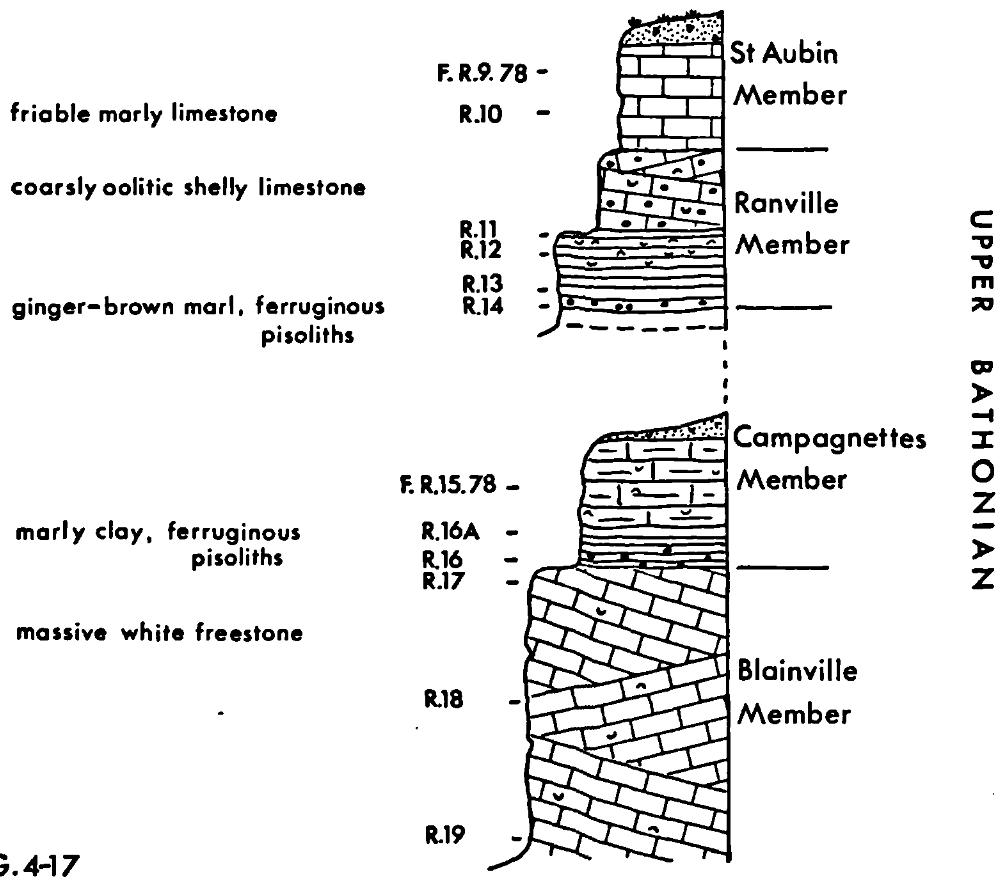


FIG. 4-17

bands occur within the limestone. The sediments yielded a poor ostracod fauna.

Several small disused quarries are situated N.W. of the village to the left of the D 23 heading N. from Quilly to La Jalousie. The same hard fine-grained limestones with interbedded chert bands are exposed here but unfortunately all samples collected were devoid of ostracods.

4-2-2-2 Occagnes

During May 1978 a temporary road section either side of the N 185 S. of Occagnes, immediately S. of the turn-off to le Mesnil exposed almost 2 m of U. Bathonian (Langrune Member?) soft cream rubbly limestones and marls (fig. 4-19). This road cutting extended S. for about 2 km. A good ostracod fauna typical of the falcata zone was obtained.

4-2-2-3 Villedieu les Bailleul

A large disused quarry is situated E. of the village on the left of the road to Tournai-sur-Dives. Here the unconformity between the L. Palaeozoics and the U. Bathonian is seen but unfortunately ostracods were not recovered from any of the samples.

4-2-2-4 Aubry-en-Exmes

The unconformity is also seen here in a small overgrown quarry adjacent to the cross-roads. The U. Bathonian is much thinner here than at Villedieu and comprises fine-grained rubbly marly limestones with abundant oysters (fig. 4-20). A rather poor ostracod fauna was recovered.

4-3 Boulonnais

4-3-1 Boulogne, Carrière des Pichottes (Le Wast)
(Arkell, 1956)

This is very much a classic U. Bathonian section although the quarry is now disused and largely overgrown. It is situated in a field just to the left of the N 42 at the junction of the D 127 heading E. from Boulogne.

The U. Bathonian (discus ammonite zone) beds are typical marginal marine sediments being largely shallow marine limestones with interbedded clays containing brackish and fresh water ostracods and some charophytes. The topmost bed is the 'Calcaire des Pichottes', a fossiliferous oolitic

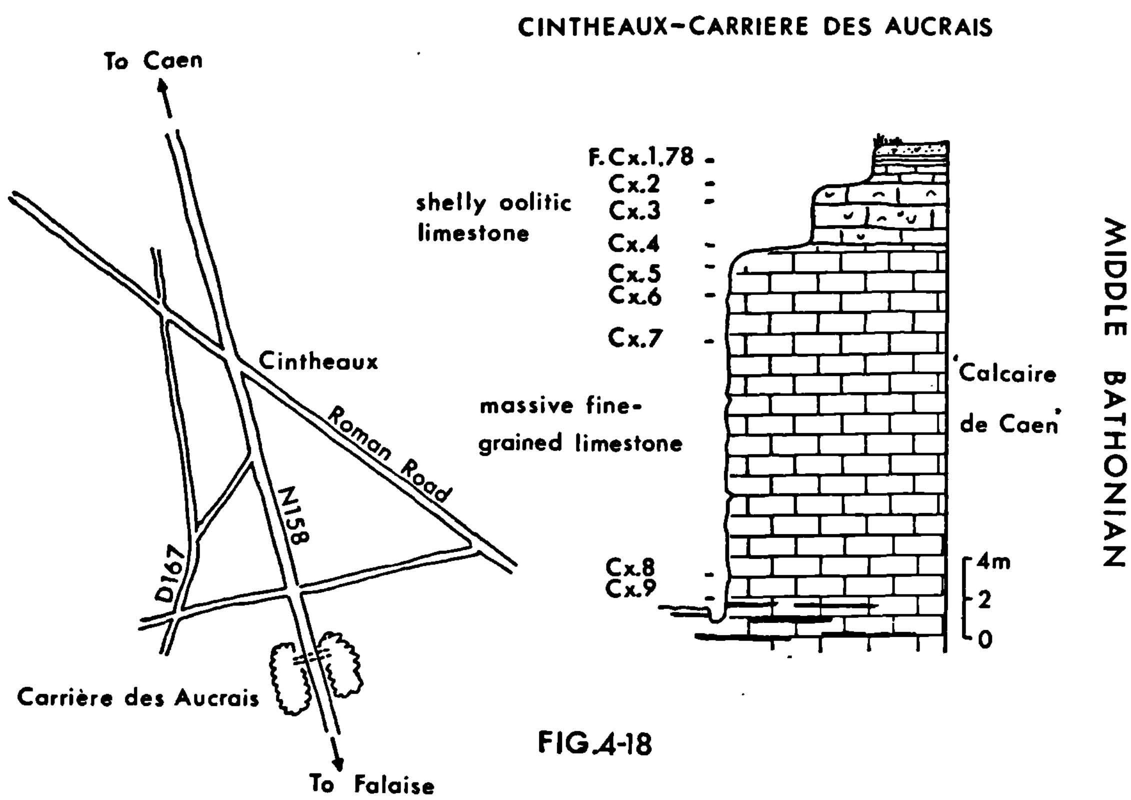


FIG.4-18

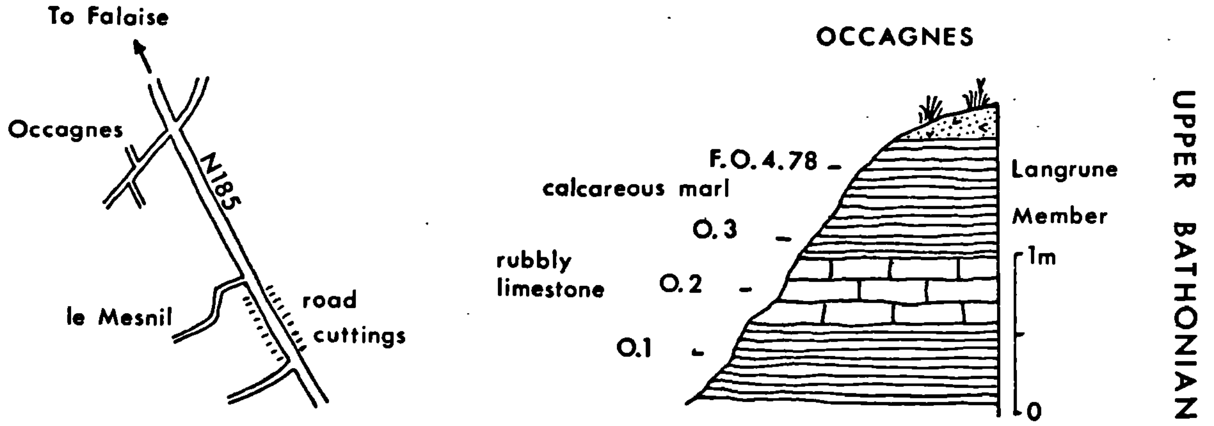


FIG. L19

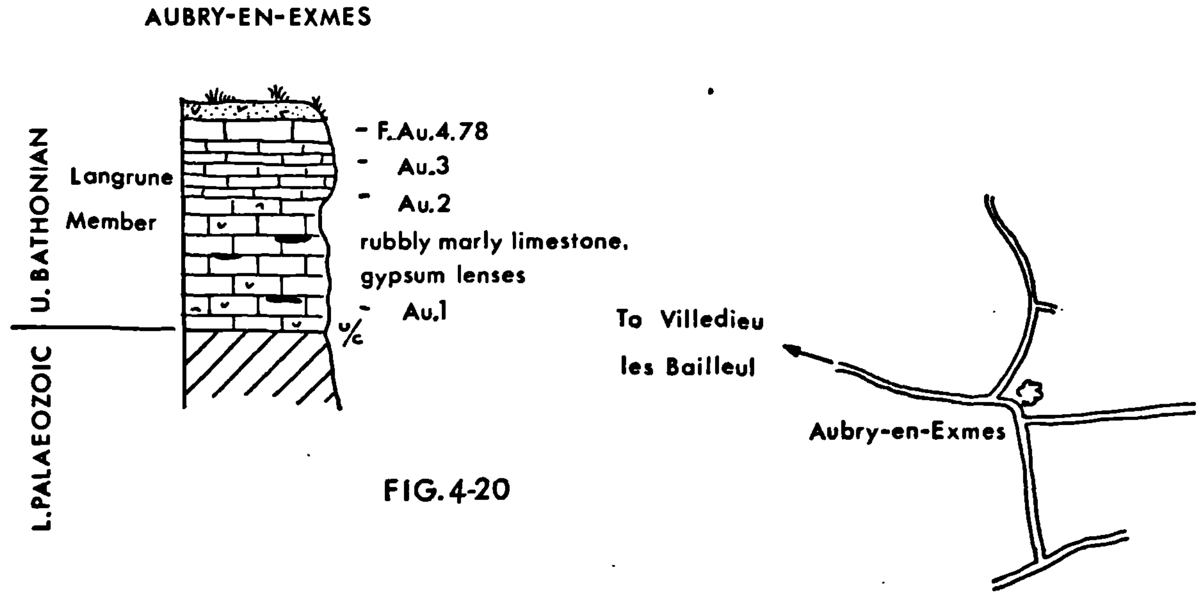
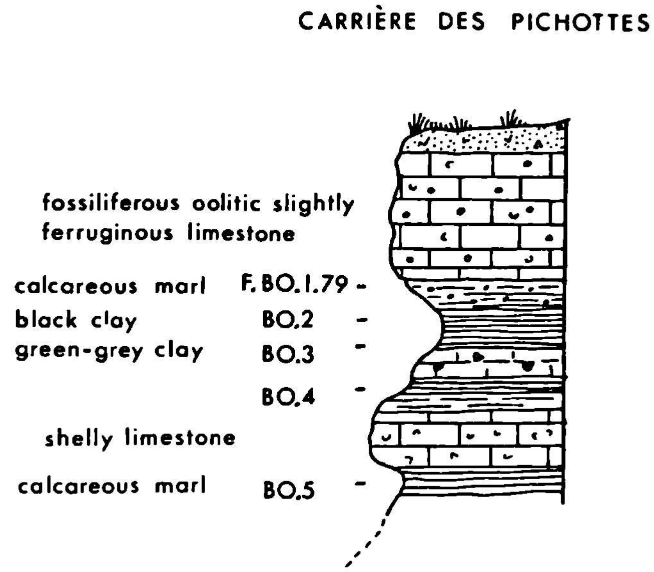


FIG.4-20



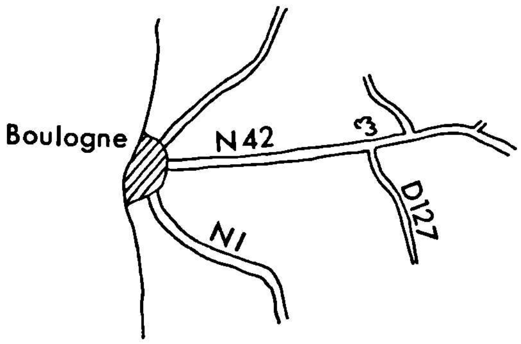


Figure 4-21-1

Figure 4-21-2 The Upper Bathonian section at Les Pichottes Quarry

limestone of the L. Cornbrash. Beneath this are a series of calcareous marls and clays, with abundant rhynconellids, and shelly limestone, equivalent to the upper part of the Forest Marble. An extremely rich ostracod fauna was obtained from the softer horizons (see fig. 4-21), a part of which has been previously published by Oertli (1957, 1959) although a large number of new forms have yet to be described.

CHAPTER 5

Systematic Descriptions

This chapter deals with the taxonomy of the species present in the study area. The greater part of the fauna is included here though a few unidentifiable forms of no stratigraphical significance are excluded. A full description is given only to new species; in all other cases the reader is referred to the relevant original reference. The nomenclature used in describing the structural features of the ostracod shell follows that of Moore (1961) and Sylvester-Bradley (1948) with additional hinge terminology by Bate (1972). The terms 'small, 'medium' and 'large' have been avoided for the most part except in certain instances where it is felt necessary to stress the size of the species or genus. In such cases the size is defined.

All the specimens referred to in this chapter have a registration number; those collected at outcrop from Normandy and Boulogne are prefixed OS and are housed in the British Museum (Natural History), London. Those from the subsurface material of southern England are represented by the variety of prefixes other than OS and are housed in the Institute of Geological Sciences, Leeds.

Every species listed in this chapter is illustrated by scanning electron micrographs. In the case of new species, the designated holotype is further illustrated by the use of a stereo-pair of micrographs. For suitable specimens marginal pore canal photographs, taken by Mr. Peter York of the British Museum (Natural History), are also included.

Complete range-tables for the subsurface sections and for the Port-en-Bessin section are found in the appendix as well as species lists for the remaining French sections. In addition, as each ostracod family is dealt with in turn there is a further range-table for members of that family alone in the 3 sampling provinces, showing the pattern of species distribution within the study area.

Subclass Ostracoda Latreille, 1806

Order Podocopida Müller, 1894

Suborder Platycopa Sars, 1866

Family CYTHERELLIDAE Sars, 1866

Genus Cytherella Jones, 1849

REMARKS. There has been a good deal of dispute regarding the taxonomic status of Cytherella and Cytherelloidea. In the "Treatise on Invertebrate Palaeontology" Reyment (1961, 383) regards Cytherelloidea as a subgenus of Cytherella, basing his distinctions on ornament and shape in dorsal view. Kaye (1963), working L. Cretaceous species, considers the two to be distinct genera, with strong ornament, absence of overlap anteriorly and subparallel dorsal and ventral margins being diagnostic features of Cytherelloidea. Van Morkhoven (1963) and later Field (1966) also regarded the two genera as separate units but base the distinction on contrasting ornament and differing dimorphic bulges, Cytherella having one and Cytherelloidea having two posterior bulges in the female.

Here, the two are considered distinct genera on the basis of ornamentation and generally more elongate subrectangular outline in Cytherelloidea.

The ranges of the present species of Cytherella and Cytherelloidea are shown on Table 5-1.

Cytherella symmetrica Jones, 1849

(Pl. 1 figs. 1,2)

1884 Cytherella symmetrica Jones, 768, pl. 34, fig. 42.

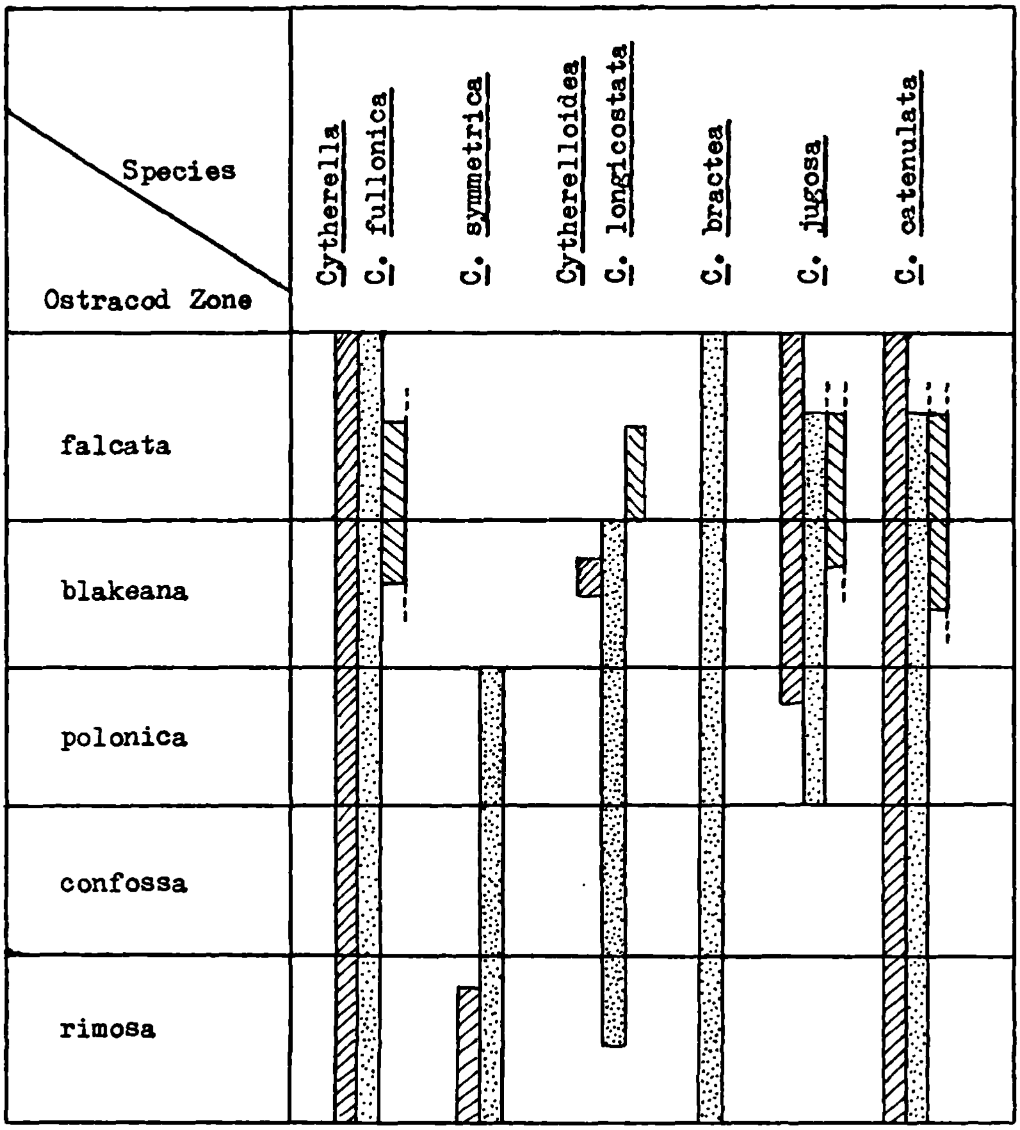
1884 Cytherella subovata Jones, 773, pl. 34, fig. 34.

1969 Cytherella symmetrica Jones; Bate, 380, pl. 1, figs. 1, 2.

DIAGNOSIS. Large species (> .80 mm long) of Cytherella with elongate-oval carapace. Right valve uniformly overreaches left valve all round.

MATERIAL. 80 valves and carapaces.

DESCRIPTION. For full description see Bate (1969).



Key for all Tables:

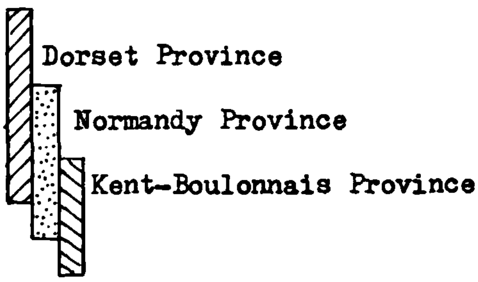


Table 5-1 Range table for species of Cytherella and Cytherelloidea

Explanation of Plate 1

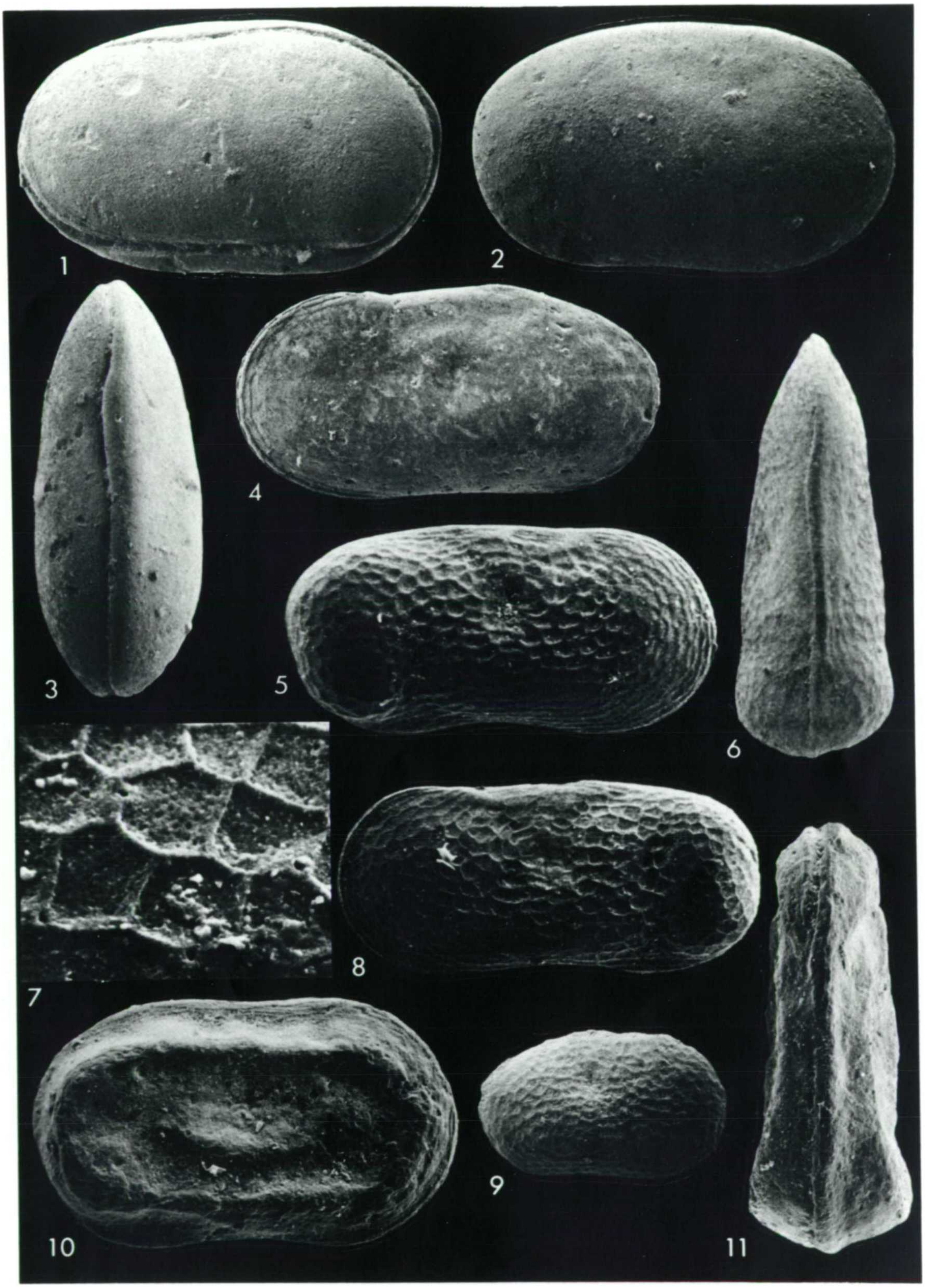
Figs. 1 - 3 Cytherella symmetrica Jones: fig. 1, ♀ car., L side, OS 11540 (.79 mm long, x 88); fig. 2, ♀ car., R side, OS 11542 (.74 mm long, x 94); fig. 3, ♀ car., dors., OS 11541 (.76 mm long, x 92). All from L. Bathonian, Marnes de Port-en-Bessin, Arromanches (F-A.4.78).

Fig. 4 Cytherella fullonica Jones & Sherborn, LV, OS 11538 (.61 mm long, x 114), U. Bathonian, Langrune Member, Amfréville (F-AV.1.78).

Figs. 5 - 9 Cytherelloidea catenulata (Jones & Sherborn): figs. 5, 6, ♀ car., R side and dors., OS 11532 (.59 mm long, x 118), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.6.78); figs. 7, 8 ♀ LV, OS 11531 (.62 mm long): fig. 7, ornament (x 500), fig. 8, ext. lat. (x 112), L. Bathonian, as above (F-PB.5.78); fig. 9, juv. RV, OS 11535 (.42 mm long, x 95), L. Bathonian, as above (F-PB.8.78).

Figs. 10,11 Cytherelloidea jugosa (Jones): fig. 10, RV, OS 11526 (.59 mm long, x 118), U. Bathonian, St. Aubin Member, St. Aubin-sur-mer (F-SA.6.78); fig. 11, ♀ car., dors., OS 11529 (.57 mm long, x 122), U. Bathonian, Campagnettes Member, Ranville Cement Works (F-R.4.78).

PLATE 1



DISTRIBUTION. The type-locality of this species is a boring in Richmond, Surrey, at a depth of 1151 ft. 6 ins. in 'Great Oolite', U. Bathonian. There are no other published records of the species. It is recorded herein from L. to U. Bathonian (rimosa to polonica Zones) at several locations in the Normandy Province, and from the L. Bathonian of the Seabarn Farm and Frome boreholes, Dorset Province.

ECOLOGY. Shallow water marine, sublittoral.

REMARKS. Jones originally designated two species, C. symmetrica and C. subovata from the female and male dimorphs respectively of C. symmetrica. This was unnoticed until 1969 when Bate placed C. subovata in synonymy. C. symmetrica is a particularly large (>.80 mm long) species of the genus, somewhat similar to two oval species: C. suprajurassica Oertli (1957, 649, pl. 1, figs. 1-10) and C. index Oertli (1959, 16, pl. 1, figs. 13-25), however C. symmetrica is larger than both these species. C. suprajurassica is further distinguished by having a greater mid-dorsal projection of the RV over the LV, giving a strongly arched dorsal outline. In. C. index the greatest overreach of the RV over the LV occurs slightly posterior of the centre. In C. symmetrica this overreach is evenly developed along the dorsal margin. Juveniles of C. symmetrica are similar to adults of C. fullonica but are distinguished on their absence of a posteromedian muscle scar depression, and more gently sloping posterodorsal slope.

Cytherella fullonica Jones & Sherborn, 1888

(Pl. 1, fig. 4)

1888 Cytherella fullonica Jones & Sherborn, 274, pl. 1, figs. 12a-c

1963 Cytherella fullonica Jones & Sherborn; Bate, 184, pl. 1, figs, 1, 2.

1969 Cytherella fullonica Jones & Sherborn; Bate, 395, pl. 5, fig. 9; pl. 6, fig. 1.

1970 Cytherella fullonica Jones & Sherborn; Whatley, 313, pl. 1, figs. 12-14, 16, 18.

DIAGNOSIS. Subrectangular species of Cytherella with an obliquely-angled posterodorsal slope. Shell surface smooth.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Bate (1963, 184).

DISTRIBUTION. C. fullonica is a very common Jurassic ostracod, previously recorded from the L. Bathonian of Somerset; M. Bajocian of Lincolnshire; Callovian of Oxfordshire and Skye; L. Oxfordian of Sutherland. Herein it is recorded from L. to U. Bathonian (rimosa to falcata Zones) sediments of most of the localities sampled in S. England and Normandy and, more rarely, in the Kent-Boulonnais Province.

ECOLOGY. Shallow water marine, sublittoral.

REMARKS. Sexual dimorphism has not been observed in this species.

C. fullonica is a long-ranging ostracod and, as such, is of little stratigraphic use.

Genus Cytherelloidea Alexander, 1929

Cytherelloidea catenulata (Jones & Sherborn, 1888)

(Pl. 1, figs. 5-9)

1888 Cytherella catenulata Jones & Sherborn, 274, pl. 5, figs. 6a-c.

1948 ?Cytherelloidea catenulata (Jones & Sherborn); Sylvester-Bradley, 200, pl. 14, fig. 11.

1963 Cytherelloidea catenulata (Jones & Sherborn); Bate, 184, pl. 1, figs. 3-6.

1963 Platella jurassica Bate, 185, pl. 1, figs. 7-10.

DIAGNOSIS. Species of Cytherelloidea with reticulate shell surface. Sexual dimorphism pronounced; females bear a crescentic swelling near posterior margin, the dorsal limb of which bends over and curves forwards close to ventral margin, producing a question-mark-shaped swelling.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Bate (1963, 184, 185) for full description.

DISTRIBUTION. Previously recorded from the L. Bathonian, L. Fuller's Earth, near Bath, Somerset (type-locality) and from the U. Bajocian of N. Lincolnshire. It is recorded here from L. to U. Bathonian sediments (rimosa to falcata Zones) from several of the Dorset Province borehole sequences, from U. Bathonian (blakeana to falcata Zones) of the Kent-Boulonnais

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Province and L. to U. Bathonian (rimosa to falcata Zones) of Normandy. In all three provinces it is a common element of the fauna.

ECOLOGY. Marine, occurring in a wide variety of lithofacies types.

REMARKS. Platella was erected by Coryell and Fields in 1937 as a genus distinct from Cytherella and Cytherelloidea characterised by its thin shell, oval to subrectangular outline, having a punctate ornamentation and a shallow dorsomedian sulcus. The small size (the Miocene type-species, P. gattunensis, being .42 mm long) was also considered diagnostic. In 1963 Bate figured a Bajocian species of the genus, P. jurassica. This is somewhat larger than the type-species (holotype length = .64 mm) and occurs in the same bed, the Kirton Shale, as Cytherelloidea catenulata. I consider that Platella, as a distinct genus, is invalid and should be considered synonymous with Cytherelloidea. The type-species P. gattunensis and P. jurassica therefore represent pre-adult forms of Cytherelloidea.

The shell surface of C. catenulata is finely punctate and is ornamented by a well developed reticulate network of small murae. Simple normal pore canal openings are situated at the junctions of these murae (see pl. 1, fig. 7).

C. catenulata differs from Cytherella concentrica Field, 1966, from the L. Lias of Dorset by being more rectangular in outline, having a straight rather than gently arched dorsal margin and by being more incurved ventrally (just in front of the posterior swelling in the female). The very strong similarity in the ornamentation of the two species does, nevertheless, suggest a phylogenetic link.

Cytherelloidea jugosa (Jones, 1884)

(Pl. 1, figs. 10, 11)

1884 Cytherella jugosa Jones, 773, pl. 34, fig. 44.

1969 Cytherelloidea jugosa (Jones); Bate, 381, pl. 1, figs. 3, 4, text. fig. 1.

DIAGNOSIS. Subrectangular species of Cytherelloidea with a broad peripheral rib on both valves and a central sigmoid ridge. Ventral margin strongly incurved.

MATERIAL. 55 valves and carapaces.

DESCRIPTION. See Bate (1969, 381).

DISTRIBUTION. The type-locality of this species is a boring in Richmond, Surrey, at a depth of 1205 ft. in 'Great Oolite', U. Bathonian. It is recorded here from U. Bathonian (polonica to falcata Zones) of the Dorset and Normandy Provinces and U. Bathonian (blakeana to falcata Zones) of the Kent-Boulonnais Province.

ECOLOGY. Marine, preferring a shallow-water limestone facies.

REMARKS. C. jugosa is similar to C. paraweberi Oertli (1957, 651, pl. 1, figs. 12-15) but differs by being rounded rather than angular posterodorsally, by being more incurved ventrally and by being narrower anteriorly. The ribs in C. paraweberi are more clearly defined, being much narrower than in C. jugosa.

This is the first record of C. jugosa in the French Jurassic sediments, although a similar form, C. sp. B has been noted from the Kimmeridgian of the Paris Basin (Guyader, 1969, 221, pl. 33, figs. 17-19). The peripheral rib is not pronounced in this species and the median rib appears to extend further anteriorly and posteriorly. Guyader recorded this together with C. paraweberi and C. weberi Steghaus 1951, both of which are Kimmeridgian species. It is possible that these three forms evolved simultaneously from C. jugosa stock. C. jugosa itself is restricted to the U. Bathonian.

The specimens figured here exhibit a faint reticulation towards the valve edges and on the median ridge. This has not been previously observed but is most probably due to the improved resolution of the modern S. E. M.

Cytherelloidea longicostata sp. nov.

(Pl. 2, figs. 1-10)

1981 Cytherelloidea sp. cf. C. sp. A Oertli; Sheppard, pl. 3, fig. 13.

DIAGNOSIS. Species of Cytherelloidea with four long and one short diagonal lateral ribs. A strong peripheral rim runs around anterior, posterior and ventral margins. Shell surface reticulate. Pronounced sexual dimorphism.

MATERIAL. 46 valves and carapaces.

HOLOTYPE. Male carapace, OS 11503, Ranville Member, U. Bathonian (blakeana Zone), St. Aubin-sur-mer, Normandy.

Explanation of Plate 2

Figs. 1 - 10 Cytherelloidea longicostata sp. nov.

Fig. 1 ♂ RV, int., OS 11508 (.52 mm long, x 134), M Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.26.78).

Figs. 2, 3, 7, 8 holotype, ♂ car., OS 11503 (.54 mm long): fig. 2, stereo-pair of R side (x 129); fig. 3, muscle scars (x 500); fig. 7, dors. (x 129); fig. 8, vent. (x 129), U. Bathonian, Ranville Member, St. Aubin-sur-mer (F-SA.2.78).

Fig. 4 ♀ car., dors., OS 11513 (.62 mm long, x 112), U. Bathonian, St. Aubin Member, Amfréville (F.AV.10.78).

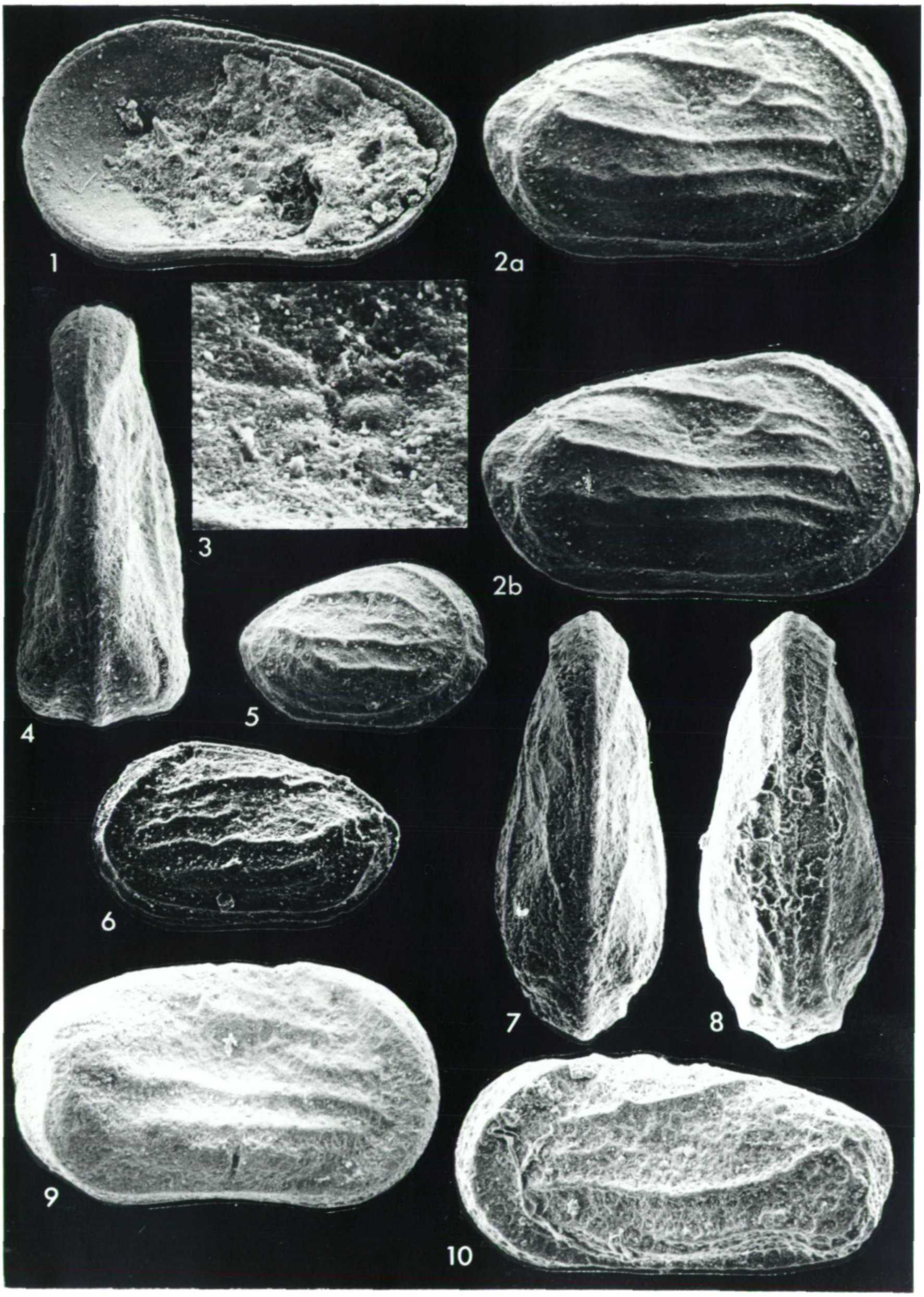
Fig. 5 juv. car., R. side, OS 11515 (.26 mm long, x 153), M. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.28.78).

Fig. 6 juv. car., L side, OS 11514 (.35 mm long, x 142), U. Bathonian, Ranville Member, St. Aubin-sur-mer, (F-SA.2.78).

Fig. 9 ♀ car., R side, OS 11516 (.59 mm long, x 118), U. Bathonian, Campagnettes Member, Carriere des Campagnettes, Ranville (F-R.16A.78).

Fig. 10 ♂ LV, OS 11510 (.56 mm long, x 125), L. Bathonian, Marnes de Port-en-Bessin, Arromanches (F-A.3.78).

PLATE 2



DESCRIPTION. Subquadrate carapace with greatest height in anterior third passing through anterior cardinal angle, longest medially and widest in posterior third. Anterior margin broadly rounded with strong carina-like rim parallel to it, extending dorsally to anterior cardinal angle and ventrally to posterior cardinal angle, leaving straight dorsal margin free. A strong lateral rib passes diagonally from anteromedian position to just below posterior cardinal angle. Two similar ribs run parallel, horizontally below this, and above it a fourth rib runs from anterior backwards and upwards to finish mid-dorsally in a short curved section paralleling dorsal margin. A short fifth rib runs from anterior margin to muscle-scar depression situated dorsomedially. RV larger than LV which it overreaches slightly on all sides. Valve surfaces covered by a faint hexagonal reticulation, more pronounced along anterior margin in front of marginal rim.

Females are longer and less high than males and are greatly swollen posteriorly.

Muscle scars are a rosette of 7 or 8 oval scars. Hinge, typical of the genus is simply the selvage of LV fitting into a groove in RV.

DISTRIBUTION. Occurs in sediments from L. to U. Bathonian age (rimosa to blakeana Zones) at several locations in the Normandy Province, U. Bathonian (falcata Zone) of the Kent-Boulonnais Province, and in the Dorset Province is found only in the U. Bathonian (blakeana Zone) of Seabarn Farm borehole.

ECOLOGY. Shallow-water marine, favouring a littoral to neritic environment.

DIMENSIONS

			L	H	W	Locality
holotype,	♂ car.,	OS 11503	.54	.31	.21	F-SA.2.78
paratypes:	♂ RV,	OS 11508	.52	.30		F-PB.26.78
	♂ car.,	OS 11509	.55	.29	.27	F-SA.4.78
	♂ LV,	OS 11510	.56	.27		F-A.3.78
	♀ car.,	OS 11511	.62	.31	.25	F-R.15.78
	juv. RV,	OS 11512	.39	.25		F-PB.49.78
	♀ car.,	OS 11513	.62	.34	.25	F-AV.10.78
	juv. car.,	OS 11514	.35	.22	.16	F-SA.2.78
	juv. car.,	OS 11515	.26	.17	.12	F-PB.28.78
	♀ car.,	OS 11516	.59	.31	.25	F-R.16A.78

REMARKS. C. longicostata is very similar to C. sp. A Oertli (1972, pl. 2, figs. 29, 30) from Jurassic deposits of DSDP leg 11 in the western Atlantic. This is interesting because Oertli regards sp. A as a deep water, Tethyan species, occurring with bathyal forms Bairdia (Akidobairdia) farinacciae Oertli, 1967 and B. italica Oertli, 1967. He considers the sediments to be U. Jurassic in age. C. sp. A differs from C. longicostata by having two short additional ribs in the posterior cardinal angle region, and in the apparent absence of the lowermost longitudinal rib. It is also smaller, although the only two specimens recovered may both have been pre-adults. The close similarities in the two species suggests a phylogenetic relationship, C. longicostata representing the M. Jurassic praecursor of C. sp. A where it inhabited littoral to neritic shelf environments of the epicontinental sea lying to the north of the Tethys. A westerly migration of C. longicostata into progressively deeper waters, accompanying opening of the Atlantic Ocean from the M. Jurassic onwards, is postulated. Evolution into the C. sp. A form would have occurred over the 10 to 20 million year period, morphological change being only slight because, as Oertli pointed out, the sedimentary environment in which C. sp. A was found was one in which "evolutionary stress" was non-existent.

Cytherelloidea bractea sp. nov.

(Pl. 3, figs. 1-10)

1981 Cytherelloidea sp.; Sheppard, pl. 3, fig. 16.

DERIVATION OF NAME. Latin, meaning thin plate or scale referring to the type of ornament.

DIAGNOSIS. Species of Cytherelloidea with strong median lateral rib which bends up posteriorly and anteriorly. A second shorter rib runs beneath this. Between median rib and dorsal margin a third short rib parallels dorsal margin, in some specimens bending down posteriorly to join end of median rib. Well developed reticulate ornamentation in the form of small hexagonal scales over valve surfaces. Sexual dimorphism pronounced.

MATERIAL. 31 valves and carapaces.

HOLOTYPE. Female left valve, OS 11517, Marnes de Port-en-Bessin, L.

Bathonian (rimosa Zone), Port-en-Bessin, Normandy.

DESCRIPTION. Carapace subrectangular with broadly rounded anterior margin and truncate posterior. Greatest length medially; greatest height in anterior third in males but in anterior or posterior third in females; greatest width in posterior third. Ventral margin medially concave, dorsal margin sloping to posterior from anterior cardinal angle in males, in females dorsal margin is more or less straight. Posterior cardinal angle therefore higher in females. A broad peripheral border extends around anterior margin only. Valve surfaces covered by a well-developed reticulate ornament. Ribbing details as for diagnosis. Females generally longer than males and possess two well-defined posterior swellings.

Muscle scars, situated in a shallow dorsomedian depression, can be observed externally as two vertical rows of about 4 oval scars, the posterior 4 being longer. Hinge as for genus.

DISTRIBUTION. Occurs in sediments from L. to U. Bathonian age (rimosa to falcata Zone) at several localities in the Normandy Province only.

DIMENSIONS.

			L	H	Locality
holotype,	♀ LV,	OS 11517	.59	.29	F-PB.45.78
paratypes:	♂ RV,	OS 11506	.53	.30	F-PB.40.78
	♂ RV,	OS 11518	.54	.31	F-PB.28.78
	♂ RV,	OS 11519	.52	.30	F-PB.48.78
	♂ LV,	OS 11520	.56	.29	F-A.4.78
	♀ RV,	OS 11521	.61	.33	F-PB.24.78
	juv. RV,	OS 11522	.53	.28	F-PB.38.78
	juv. LV,	OS 11523	.39	.22	F-PB.42.78
	♂ LV,	OS 11524	.59	.29	F-L.2.78
	♂ RV,	OS 11525	.57	.32	F-PB.38.78

ECOLOGY. Shallow water marine, favouring a littoral to neritic environment.

REMARKS. Examined closely, the ornamentation in C. bractea appears to result from partial decomposition of the outermost layer of shell in definite hexagonally-shaped patches, leaving many areas as smooth hexagonal, slightly raised plates. The dissolution or fragmentation of the epicuticular layer reveals a primary ornamentation of punctae on the underlying median layer. Dépêche (1979) has

Explanation of Plate 3

Figs. 1 - 10 Cytherelloidea bractea sp. nov.

Figs. 1, 5, 9 ♂ RV, OS 11506 (.53 mm long): fig. 1, ext. lat. (x 132); fig. 5, dors. (x 132); fig. 9, detail of ornament (x 590), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.40.78).

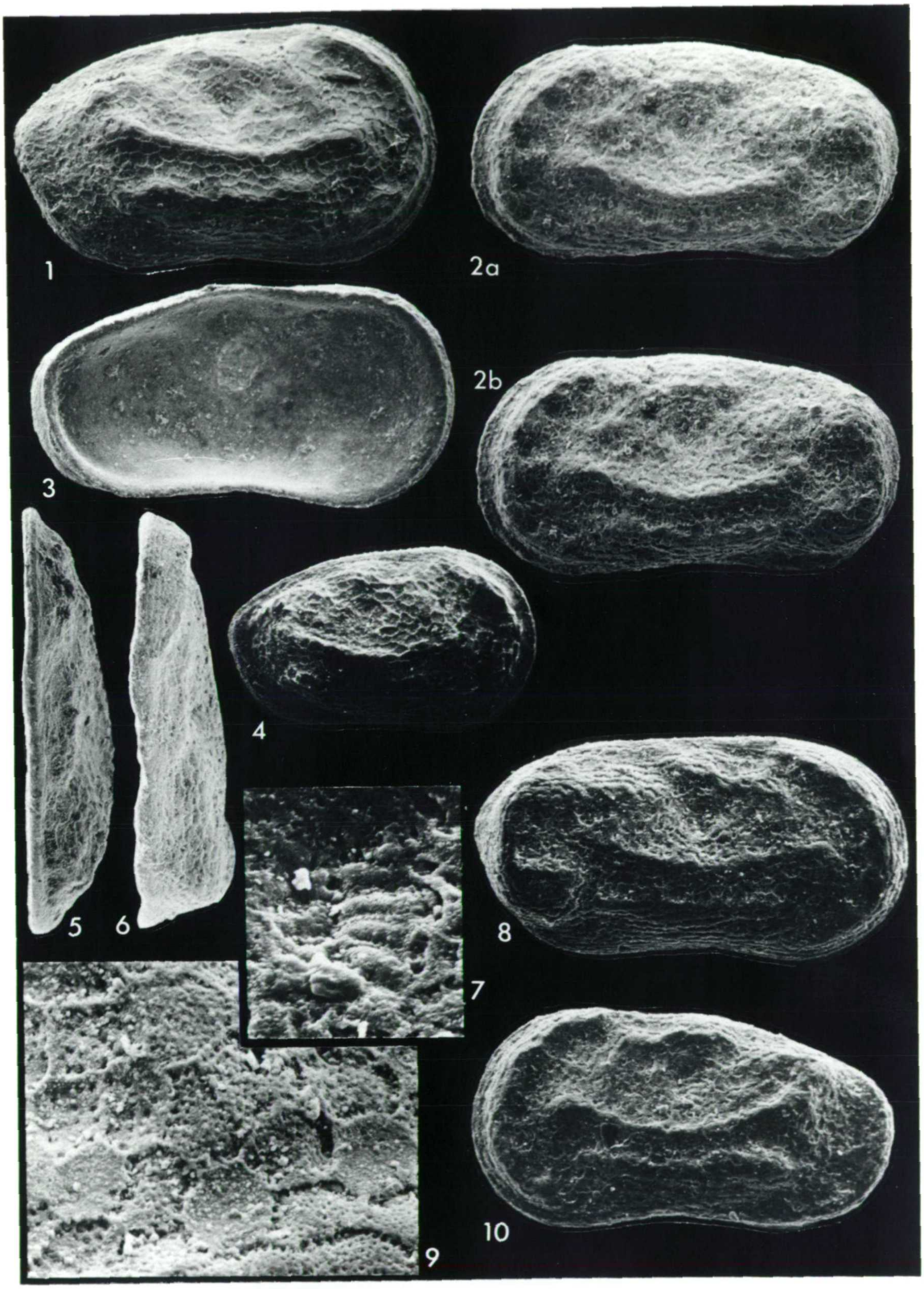
Fig. 2 stereo-pair of holotype, ♀ LV, OS 11517 (.59 mm long, x 118), L. Bathonian, as above (F-PB.45.78).

Figs. 3, 7, 10 ♂ LV, OS 11520 (.56 mm long); fig. 3, int. lat. (x 125); fig. 7, ext. lat. (x 125); fig. 10, muscle scars (x 500), L. Bathonian, Marnes de Port-en-Bessin, Arromanches (F-A.4.78).

Fig. 4. juv. RV, OS 11522 (.53 mm long, x 94), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.38.78).

Figs. 6, 8 ♀ RV, OS 11521 (.61 mm long): fig. 6, dors. (x 114); fig. 8, ext. lat. (x 114), L. Bathonian, as above (F-PB.24.78).

PLATE 3



found similar structures on species of Rutlandella. She believes that in many cases the epicuticular layer may mask an underlying ornamentation on the median layer which may take the form of punctae, tubercles or reticulation. The reticulation of C. bractea is probably, therefore, a secondary feature. This species is distinguished from C. sp. 528 Buck, 1954 (figured in Oertli, 1959, 18, pl. 2, fig. 30, from the L. and M. Oxfordian of the Swiss Juras) by being smaller (Oertli states a length of .68 mm) and in the latter possessing a peripheral rim around the entire valve margins. The ribbing pattern is, however, very similar in the two forms.

In his 1972 paper on the supposed U. Jurassic ostracods from DSDP leg 11 in the western Atlantic, Oertli figures a C. sp. B in association with his C. sp. A which has already been discussed under C. longicostata. C. sp. B differs from the present species by having a slight mid-dorsal projection of the RV and in the apparent absence of the third dorsal rib. It is particularly similar to males of C. bractea and its relatively small size may indicate a pre-adult stage as suggested for C. sp. A (notice also the arched dorsal outline in juveniles of C. bractea (pl. 3, fig. 4) as opposed to the straight outline of adults (pl. 3, fig. 8)). Here, therefore, is an identical situation to the C. longicostata/sp. A one in which the form favouring relatively shallow water gave rise to that preferring deeper quieter waters (see the Remarks section of C. longicostata).

Suborder Podocopina Sars, 1866

Superfamily Bairdiacea Sars, 1888

Family BAIRDIIDAE Sars, 1888

REMARKS. This is a particularly long-ranging family (L. Ordovician - Recent) in which the presence of strong ornamentation has been used as a marker of generic status. Various genera were erected by Sohn in 1954, working on Texan Permian forms, on the basis of type of sculpture or outline for smooth, sculptured or reticulated species.

During the late Triassic the Bairdiidae produced, by an explosive radiation, a whole host of strong shell ornamentations and new sculptural elements. The Bairdoppilate structure of teeth and sockets along the antero- and posterodorsal positions in the selvage of the RV and selvage groove of the LV was erroneously used by Coryell et al. (1935) to erect a new genus Bairdoppilata, and later by Kristan-Tollman (1969) to erect a sub-family, the Bairdoppilatinae. Bolz (1969), however, has shown this structure to have a merely functional meaning which cannot, therefore, be used taxonomically and in 1970 he reduced many of the genera previously erected by Kollmann (1960, 1963) and Kristan-Tollman (1969) into the one genus Bairdia on outline rather than ornamentation.

Maddocks, in her revision of Recent Bairdiidae (1969), reduced all forms into just two subfamilies, Bairdiinae corresponding to the Bairdia types, and Bythocypridinae corresponding to the Bythocypris types. Each subfamily she diagnosed on characteristic adductor muscle scar arrangements, substantiated by characteristics of the carapace and appendage morphology. Further division of the Bairdiinae, according to Maddocks, would be possible by the use of tribes, Bairdiini, Triebelinini and Carinobairdiini. For the purpose of this thesis, as no soft parts are available for study, more emphasis must be placed on the carapace characteristics; for this reason I have retained the subfamily Triebelininae for those highly ornate bairdiids with distinct peripheral ridges.

Subfamily BAIRDIINAE Sars, 1888

Genus Bairdia McCoy, 1884

Bairdia hilda Jones, 1884

(Pl. 4, figs. 11, 12)

1884 Bairdia hilda Jones, 771, pl. 34, fig. 20.

1888 Bairdia fullonica Jones & Sherborn, 253, pl. 5, figs. 4a-c.

1969 Bairdia hilda Jones; Bate, 383, pl. 1, figs. 5, 6; pl. 4, fig. 5.

DIAGNOSIS. Carapace subdeltoid in lateral outline, convex dorsally. Dorsal margin high with steeply inclined anterior and posterior slopes. Posterior margin acuminate, upturned. Shell surface finely punctate.

MATERIAL. Over 100 valves and carapaces.

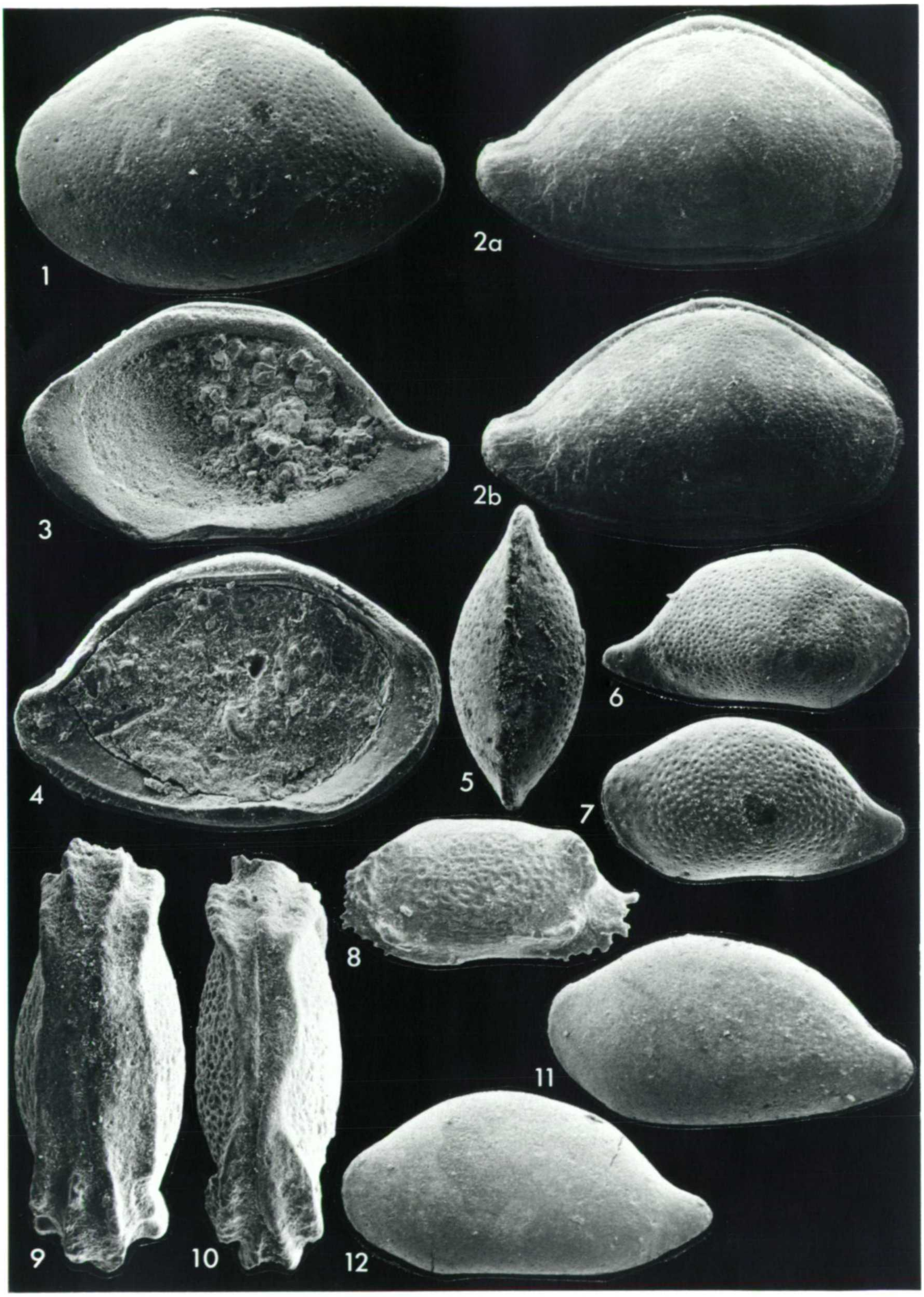
Explanation of Plate 4

Figs. 1 - 7 Bairdia pumicosa sp. nov.: figs. 1, 4, LV, OS 11557 (.96 mm long): fig. 1, ext. lat. (x 72); fig. 4, int. lat. (x 72), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.7.78); fig. 2, stereo-pair of holotype, car., R side, OS 11556 (.96 mm long, x 72), L. Bathonian as above (F-PB.4.78); fig. 3, RV, int., OS 11560 (.96 mm long, x 72), L. Bathonian as above (F-PB.1.78); figs. 5, 7, juv. car., OS 11561 (.59 mm long): fig. 5, vent. (x 84); fig. 7, L side (x 84), L. Bathonian as above (F-PB.40.78); fig. 6, juv. car., R side, OS 11562 (.74 mm long, x 67), L. Bathonian as above (F-PB.38.78).

Figs. 8 - 10 Ptychobairdia limbata sp. nov.: fig. 8, juv. LV, OS 11549 (.57 mm long, x 87), L. Bathonian as above (F.PB.49.78); fig. 9, car., vent., OS 11550 (.68 mm long, x 102), U. Bathonian, St. Aubin Member, St. Aubin-sur-mer (F-SA.4.78); fig. 10, car., dors., OS 11501 (.90 mm long, x 77), U. Bathonian as above.

Figs. 11, 12 Bairdia hilda Jones: fig. 11, car., L side, OS 11563 (.90 mm long, x 77), U. Bathonian, Ranville Member, Reviers (F-Re.13A.78); fig. 12, LV, OS 11564 (.66 mm long, x 90), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.46.78).

PLATE 4



DESCRIPTION. See Bate (1963, p. 188).

DISTRIBUTION. A commonly occurring M. Jurassic ostracod within England, ranging from Bajocian to U. Bathonian. It has previously been recorded from the Bajocian of N. England (Bate, 1963, 1964), the Great Oolite of the Richmond boring, Surrey (type locality), the U. Fuller's Earth of Bath (Jones & Sherborn, 1888; Bate, 1979) and the Forest Marble of Langton Herring, Dorset (Sylvester-Bradley, 1948). Within the study area the species occurs within all 3 sampling provinces throughout the entire Bathonian sequence.

ECOLOGY. A highly tolerant shallow water marine species, occurring within high and low energy environments, clay and carbonate facies.

REMARKS. Sylvester-Bradley was the first to point out the wide variety in shape exhibited by specimens of B. hilda. Some variants approach B. jurassica Jones, 1884 in shape but this species is distinguished on the overlap details, the LV overlapping the RV anterodorsally, posterodorsally and midventrally.

Bairdia pumicosa sp. nov.

(Pl. 4, figs. 1 - 7)

1981 Bairdia sp. Sheppard, pl. 2, fig. 8.

DERIVATION OF NAME. Latin, meaning 'porous', referring to the pitted shell surface.

DIAGNOSIS. Bairdia with high-domed dorsal outline and pitted shell surface.

MATERIAL. Over 100 valves and carapaces.

HOLOTYPE. Carapace, 0S 11556, Marnes de Port-en-Bessin, L. Bathonian, Port-en-Bessin, Normandy.

DESCRIPTION. Large, thick shelled carapace with broadly arched dorsal margin that becomes concave terminally, especially towards posterior. Shell surface ornamented by numerous small subcircular pits, evenly spaced over carapace except extreme posterior margin. Pits are more pronounced in juvenile stages. Carapace highest and widest medially and longest just ventral of mid-point (juveniles, however, are slender and are highest anteriorly, coinciding with anterior cardinal angle; pl. 4, fig. 6). Ventral margin convex in LV, slightly concave medially in RV. Anterior margin rounded, posterior margin small and pointed. LV larger than RV which it overreaches on all sides and overlaps midventrally.

Hinge typically bairdiid; in some specimens bairdoppilate structure is present (see pl. 4, fig. 3). Muscle scars not observed.

DISTRIBUTION. Occurs throughout the entire Bathonian sequence in Normandy and within the L. Bathonian L. Fuller's Earth of the Dorset Province.

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11556	.96	.51	.42	F-PB.4.78
paratypes:	LV,	OS 11557	.96	.59		F-PB.7.78
	RV,	OS 11558	.92	.50		F-Re.8.78
	RV,	OS 11559	1.05	.59		F-PB.1.79
	LV,	OS 11560	.96	.61		F-PB.7.78
	juv. car.,	OS 11561	.59	.25		F-PB.40.78
	juv. car.,	OS 11562	.74	.38		F-PB.38.78

ECOLOGY. Shallow water marine, occurring in clay, marl and limestone facies.

REMARKS. The only other distinctly pitted Bathonian bairdiid, B. sherborni Bate, 1969 is distinguished from B. pumicosa on its more rectangular lateral outline caused by a relatively long straight dorsal margin and steep postero-dorsal slope.

Subfamily TRIEBELININAE Kollmann, 1963

Genus Ptychobairdia Kollmann, 1960

Ptychobairdia limbata sp. nov.

(Pl. 5, figs. 1-4; Pl.4, figs.8-10)

1981 Ptychobairdia sp.; Sheppard, pl. 3, figs. 10, 11.

DERIVATION OF NAME. Latin, meaning bordered.

DIAGNOSIS. Species of Ptychobairdia with peripheral carina laterally, thickest anteriorly and posteriorly, weakest posteriorly. Marginal dentition antero- and posteroventrally. Shell surface reticulate.

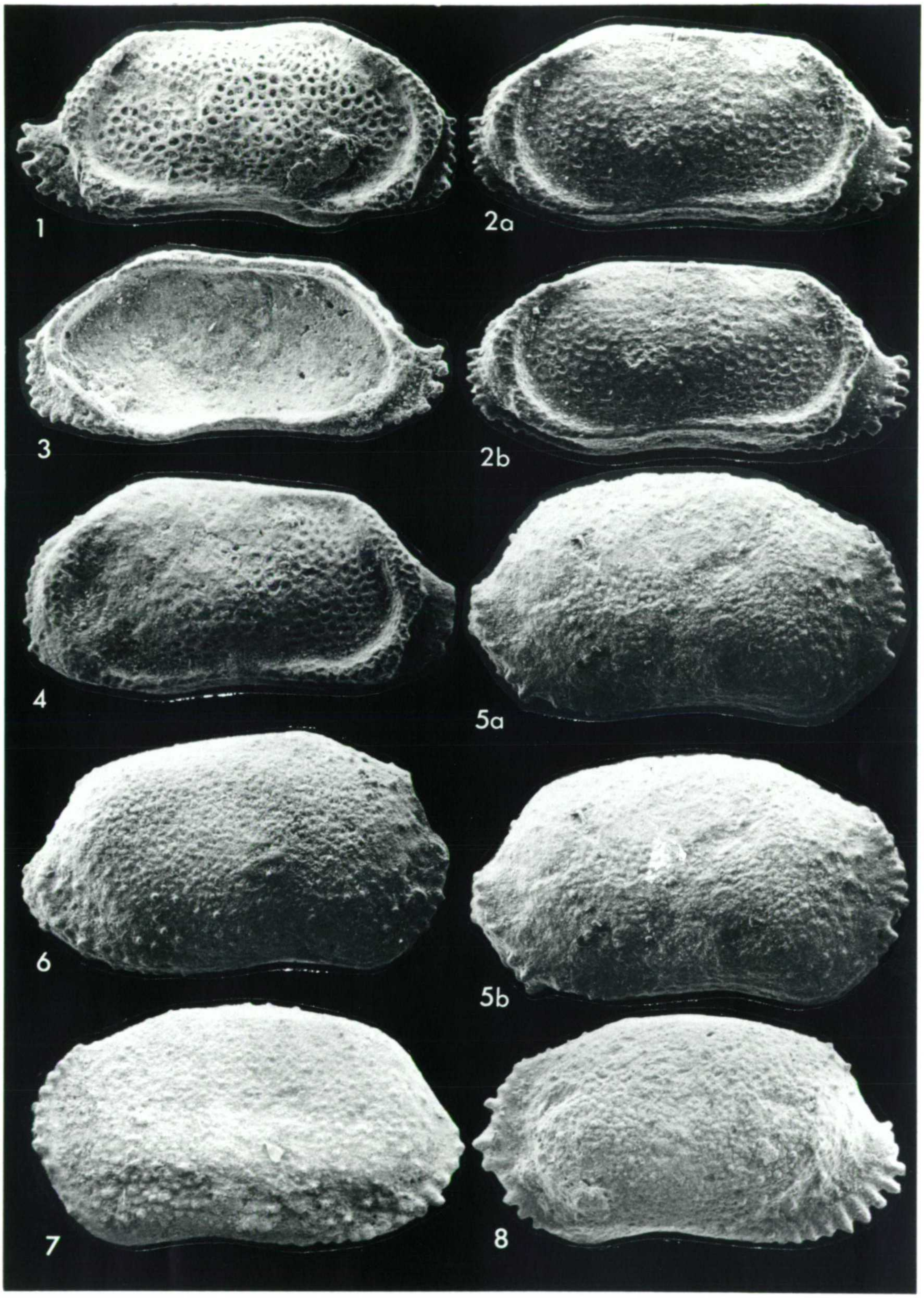
MATERIAL. 24 valves and carapaces.

Explanation of Plate 5

Figs. 1 - 4 Ptychobairdia limbata sp. nov.: figs. 1, 3, RV, OS 11547 (.91 mm long): fig. 1, ext. lat. (x 76); fig. 3, int. lat. (x 76), U. Bathonian, St. Aubin Member, Reviers (F-Re. 8.78); fig. 2, stereo-pair of holotype, LV, OS 11500 (.90 mm long, x 77), U. Bathonian, Ranville Member (F-SA. 2.78); fig. 4, LV, OS 11548 (.85 mm long, x 82), U. Bathonian, as above.

Figs. 5 - 8 Anchistrochelles ? spinosa sp. nov.: fig. 5, stereo-pair of holotype, car., R side, OS 11504 (.99 mm long, x 70), U. Bathonian, Ranville Member, St. Aubin-sur-mer (F-SA.1.78); fig. 6, car., R side, OS 11552 (.97 mm long, x 72), U. Bathonian, St. Aubin Member, St. Aubin-sur-mer (F-SA.3.78); fig. 7, car., L side, OS 11551 (.92 mm long, x 76), U. Bathonian, Ranville Member, St. Aubin-sur-mer (F-SA.1.78); fig. 8, car., L side, specimen lost, U. Bathonian, Ranville Member, St. Aubin-sur-mer (F-SA.2.78).

PLATE 5



HOLOTYPE. Left valve, OS 11500, St. Aubin Member, U. Bathonian, St. Aubin, Normandy.

DISTRIBUTION. Recorded only from the M. and U. Bathonian sediments of Normandy, polonica to falcata ostracod Zones.

DIMENSIONS.

			L	H	W	Locality
Holotype,	LV,	OS 11500	.90	.42		F-SA.2.78
Paratypes:	RV,	OS 11545	.85	.41		F-SA.2.78
	car.,	OS 11546	.68	.31	.28	F-SA.2.78
	RV,	OS 11547	.91	.42		F-Re.8.78
	LV,	OS 11548	.85	.44		F-SA.2.78
	car.,	OS 11501	.90	.42	.31	F-SA.4.78
	juv. LV,	OS 11549	.57	.30		F-PB.49.78
	car.,	OS 11550	.68	.34	.27	F-SA.4.78

DESCRIPTION. Elongate oval carapace with well rounded anterior margin and posterior margin with distinct caudal process. Ventral margin concave, dorsal margin straight with well defined cardinal angles. Carapace longest and widest medially but highest in anterior third. LV larger than RV which it overreaches uniformly all round. A peripheral carina extends along dorsal margin where it is most weakly developed, then becomes thicker anteriorly and posteriorly where it moves away from valve edges, then thins again ventrally. A strong reticulate ornamentation of subcircular pits is developed over valve surfaces, inside and including carina but dies out towards dorsal margin. Marginal dentition present antero- and posteroventrally in the form of approximately 12 short anterior and 10 short posterior spines.

Hinge is a simple groove/bar arrangement with flange of RV fitting into flange groove of LV. Muscle scars not seen.

ECOLOGY. Shallow water, near shore environment, preferring a limestone facies.

REMARKS. This is the youngest known species of Ptychobairdia. The genus was first recorded from the Alpine Trias of Austria by Kollmann (1960, 1963), Kristan-Tollmann (1969) and later, working in the same area, by Bolz (1970). Kollmann (1963) has recorded one species, P. schaubergi Kollmann, 1963 which ranges beyond the Trias into the Lias near Salzburg in Austria; Bate and Coleman (1975) have recorded an unnamed species from the Lias of the English Midlands. Apart from these, no other post-Trias species are known. The presence of a peripheral carina makes this species similar to Carinobairdia Kollmann, 1963, in particular the type-species C. triassica Kollmann, 1963. In C. triassica, however, the carina is more strongly and evenly developed and is equidistant from the valve edges, and in some species e.g. C. umbonata Kollmann, 1963 the carina is developed into a very thick swelling. Other features which place the present species into Ptychobairdia are the low dorsal outline (highly arched in Carinobairdia) and absence of bairdoppilate hinge structure which is commonly found in Carinobairdia. P. circumvallata Kristan-Tollmann, 1969 differs by being larger (holotype length 1.71 mm), by the absence of marginal spines and having the surface pitting restricted to that area of shell within the carina only. The single unnamed species recorded by Bate and Coleman (1975) is slightly larger (length 1.05 mm) and lacks the marginal spines but in all other respects appears identical. It is difficult to say with any certainty that this is the same species as P. limbata on one broken specimen only, but it could certainly represent the British L. Jurassic predecessor.

P. limbata has been found, with one exception in the clay sequence at Port-en-Bessin, only in limestone sequences, largely cross-bedded and oolitic representing deposition in shallow waters. This is unusual as the genus is a typically deeper-water Tethyan form, and apart from the English Lias species, this represents the first occurrence of the genus outside the Tethyan Province. Although Tethys was a good distance to the south, some northerly migration of the deep-water species could be expected; P. limbata probably represents the descendant of such deep-water stock, which developed and flourished in a relatively restricted niche.

Subfamily BYTHOCYPRIDINAE Maddocks, 1969

Genus Anchistrocheles Brady & Norman, 1889

?Anchistrocheles spinosa sp. nov.

(Pl. 5, figs. 5-8; pl. 6, figs. 1, 2, 7, 8)

1981 ?Anchistrocheles sp; Sheppard, pl. 3, figs. 14, 15.

Explanation of Plate 6

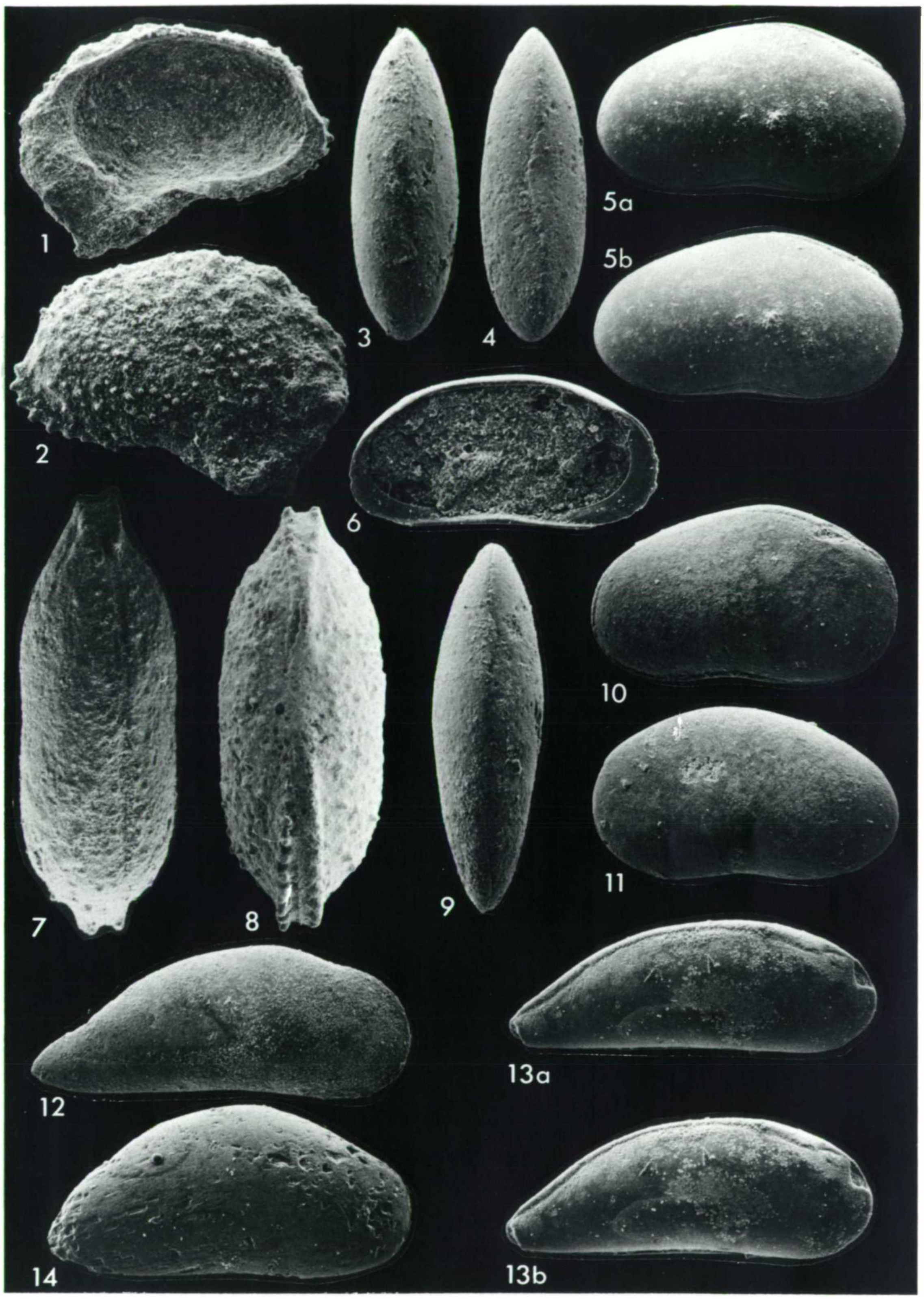
Figs. 1, 2, 7, 8. Anchistrocheles ? spinosa sp. nov.: figs. 1, 2, juv. RV, int. and ext. views, OS 11555 (.61 mm long, x 81), U. Bathonian, St. Aubin Member, Amfréville (F-AV.9.78); fig. 7, holotype, car., vent., OS 11504 (.99 mm long, x 70), U. Bathonian, St. Aubin Member, St. Aubin-sur-mer (F-SA.1.78); fig. 8, car., dors., OS 11552 (.97 mm long, x 72); U. Bathonian, as above (F-SA.3.78).

Figs. 3 - 6, 10, 11. Isobythocypris ? rotunda sp. nov.: fig. 3, car., dors., OS 11585 (.47 mm long, x 106), M. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.23.78); fig. 4, car., vent., OS 11586 (.47 mm long, x 106), M. Bathonian, as above (F-PB.21.78); fig. 5, stereo-pair of holotype, car., R side, OS 11581 (.47 mm long, x 106), L. Bathonian, Marnes de Port-en-Bessin (F-PB.35.78); fig. 6, LV int., OS 11583 (.44 mm long, x 113), L. Bathonian, as above (F-PB.39.78); fig. 10, juv. car., R side, OS 11587 (.33 mm long, x 150), L. Bathonian, as above (F-PB.32.78); fig. 11, car., L side, OS 11582 (.47 mm long, x 106), L. Bathonian, as above (F-PB.39.78).

Figs. 9, 12, 13. Paracypris asymmetrica sp. nov.: fig. 9, car., dors., OS 11568 (.63 mm long, x 95), U. Bathonian, Campagnettes Member, Ranville Cement Works (F-R.3A.78); fig. 12, RV, OS 11567 (.62 mm long, x 96). L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.6.78); fig. 13, stereo-pair of holotype, car., R side, OS 11565 (.63 mm long, x 95), L. Bathonian, as above.

Fig. 14. Paracypris terraefullonicae (Jones & Sherborn), RV, MPA 2068-C1 (.60 mm long, x 100), U. Bathonian, U. Fuller's Earth, depth 806.60 - 807.50 m, Winterborne Kingston borehole.

PLATE 6



DERIVATION OF NAME. Latin, meaning "thorny", referring to surface of shell.

DIAGNOSIS. ?Anchistrocheles with tuberculate shell surface and thickened valve margins anteriorly and posteriorly which bear a single row of numerous, short spines.

MATERIAL. 16 adult carapaces, 1 juvenile valve.

HOLOTYPE. Carapace, OS 11504, St. Aubin Member limestones, U. Bathonian, St. Aubin-sur-mer, Normandy.

DESCRIPTION. Carapace reniform with convex dorsal margin and concave sinuous ventral margin. Anterior rounded, posterior truncate due to oblique posterodorsal slope, anterodorsal slope shallow; hinge-line almost straight. Carapace laterally compressed, parallel-sided dorsally, greatest length just below median point, greatest height passing through anterior cardinal angle. Shell surface covered with small rounded tubercles; around anterior and posterior margins shell is thickened to form a narrow rim on which is a single row of more or less 12 short spines; these rims with spines continue ventrally until just before mid-point. LV larger than RV which it overlaps along dorsal margin and median part of ventral margin.

Muscle scars are typical bythocyprid-type with anterior row of 3 horizontal oval scars and 1 posteroventral scar (fig. 5-1). Adult internal features not seen. Juvenile hinge appears to be simply flange of RV fitting into flange-groove of LV. Internal marginal zone of moderate width in juvenile.

DISTRIBUTION. Found only in the Normandy Province, this species occurs in the U. Bathonian St. Aubin Member limestones of the type locality and at Amfréville, and a single juvenile valve within the M. Bathonian at the top of the Marnes de Port-en-Bessin at Bessin.

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11504	.99	.51	.34	F-SA.1.78
paratypes:	car.,	OS 11551	.92	.51	.34	F-SA.1.78
	car.,	OS 11552	.97	.51	.34	F-SA.3.78
	car.,	OS 11505	.83	.45	.31	F-SA.2.78
	car.,	OS 11553	.91	.51	.34	F-SA.1.78

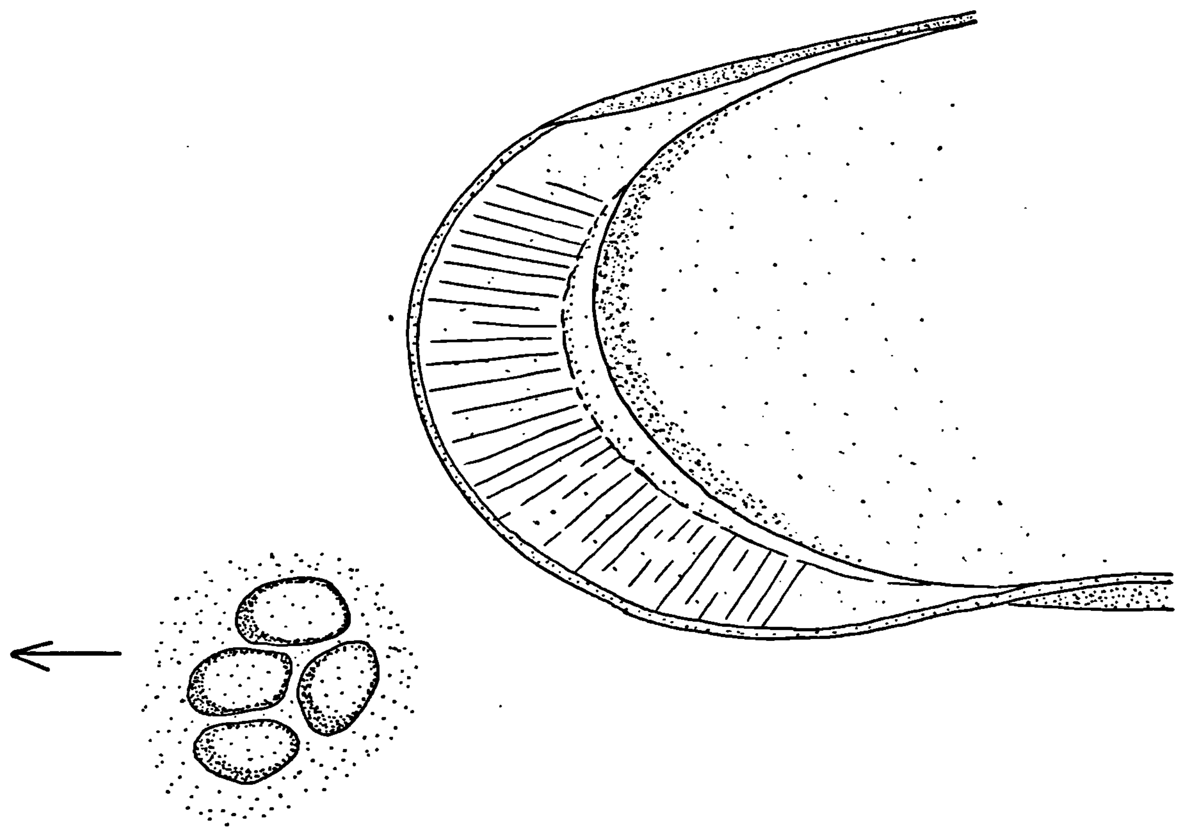
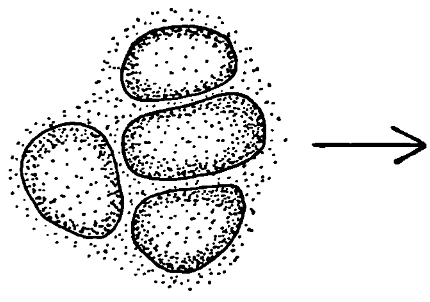


Figure 5-2 Pontocyprella subaureola sp. nov.

A. Muscle scars, OS 11578, X350

B. Anterior marginal pore canals, OS 11576, X 500

Figure 5-1



Bythocyprid-type muscle scars of

Anchistrocheles? spinosa sp. nov.,

OS 11552 X 350

		L	H	W	Locality
car.,	OS 11554	.95	.51	.35	F-SA.2.78
juv. RV,	OS 11555	.61	.38		F-AV.9.78

ECOLOGY. Shallow water marine, preferring a high energy carbonate environment.

REMARKS. Anchistrocheles is a Recent genus, diagnosed largely on its soft-part morphology. The only fossil occurrence of the genus has been recorded by Bolz who figured A. sp. A from the Alpine Trias of Austria (1971, pl. 1, fig. 13). The size and reniform carapace shape of ?A. spinosa conform with many species of the genus and the arrangement of the marginal spines is very similar to that of the Recent form A. n. sp. figured by Triebel (1960, pl. 20, figs. 44a, b). The genus here is queried, however, due to the total absence of adult internal features.

?A. spinosa is commonly associated with other ornate bairdiids, Ptychobairdia limbata sp. nov. and Bairdia spp. and as such is considered to be of probable Tethyan origin. The Recent species A. antemacella Maddocks, 1969 would agree with a deep-water habitat as it is a present-day abyssal form.

Genus Isobythocypris Apostolescu, 1959

?Isobythocypris rotunda sp. nov.

(Pl. 6, figs. 3-6, 9-11)

DERIVATION OF NAME. Latin, referring to the rounded carapace outline.

DIAGNOSIS. Small reniform carapace with strongly convex dorsal margin, concave ventral margin and broadly rounded anterior and posterior margins. Shell surface smooth.

MATERIAL. 24 valves and carapaves.

HOLOTYPE. Carapace, OS 11581, Marnes de Port-en-Bessin, L. Bathonian, Port-en-Bessin, Normandy.

DESCRIPTION. Reniform carapace with highly arched dorsal margin, apex of which lies above anterior cardinal angle. Ventral margin concave, concavity more pronounced in RV. Anterior and posterior margins well rounded and of almost equal size. Valves uniformly convex laterally. LV larger than RV which it overlaps slightly on all sides except anterior margin. Overlap is strongest along ventral margin. Carapace is longest and widest medially and highest just anterior of mid-point. Juvenile carapaces are shorter in proportion to their height and cardinal angles more pronounced.

Inner margin and line of concrescence separate, forming prominent vestibules anteriorly and posteriorly. LV hinge is a smooth groove with terminal sockets (beneath slightly overturned selvage) into which fits valve edge with slight terminal prominences of RV. Position of central muscle scar field observed although preservation too poor to determine number of scars.

DISTRIBUTION. Apart from the type level at the type locality, this species also occurs in the upper part of the Marnes de Port-en-Bessin, M. Bathonian (confossa Zone), and in the Dorset Province occurs in the Seabarn Farm borehole in the U. Fuller's Earth (polonica Zone) and Forest Marble (falcata Zone), U. Bathonian.

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11581	.47	.25	.16	F-PB.35.78
	car.,	OS 11582	.47	.25	.16	F-PB.39.78
	LV.,	OS 11583	.44	.23		"
	RV.,	OS 11584	.48	.25		F-PB.35.78
	car.,	OS 11585	.47	.25	.16	F-PB.23.78
	car.,	OS 11586	.47	.25	.16	F-PB.21.78
	juv. car.,	OS 11587	.33	.19		F-PB.32.78

ECOLOGY. Shallow water marine, found typically in clay/marl facies.

REMARKS. Isobythocypris was erected by Apostolescu in 1959, working on a Lias fauna from the Paris Basin, as distinct from the Recent Bythocypris which, as a genus, has often been misapplied to smooth-shelled forms of indeterminate outline. The general shape and overlap characteristics of ?I. rotunda are the same as the type-species I. unispinata, though being considerably smaller. The genus is, however, queried because of the poor preservation of the internal features.

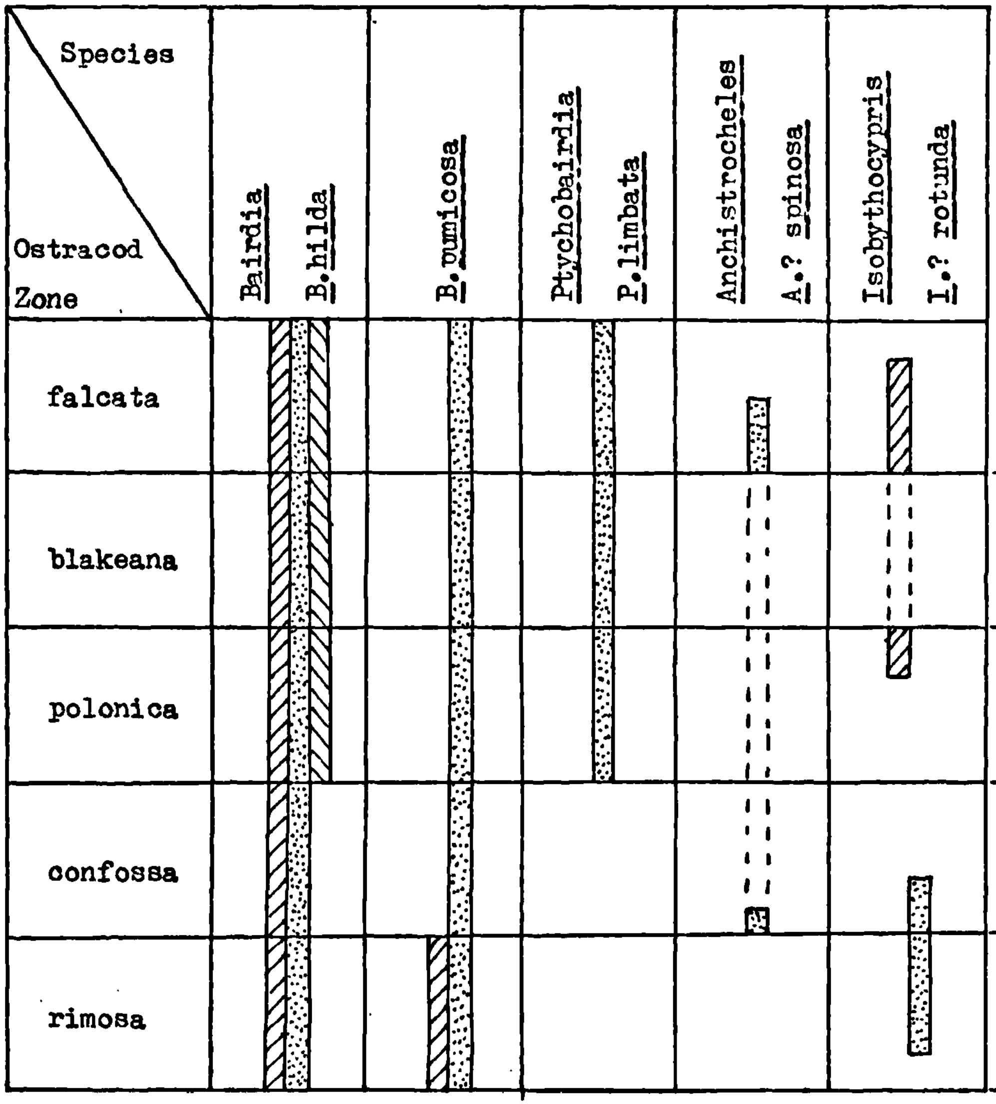


Table 5-2 Range table for members of the Bairdiidae.

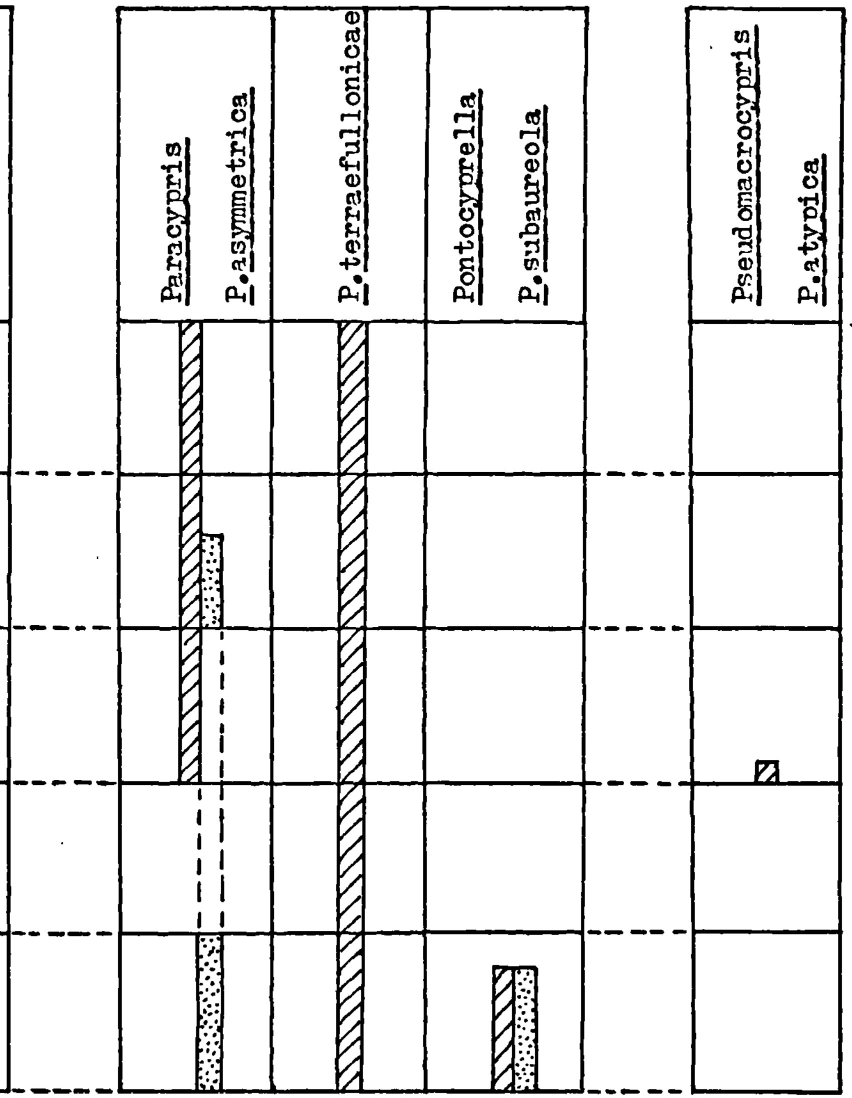


Table 5-3 Range table for members of the Paracyprididae and the Macrocyprididae.

Superfamily Cypridacea Baird, 1845

Family PARACYPRIDIDAE Sars, 1923

Genus Paracypris Sars, 1866

Paracypris asymmetrica sp. nov.

(Pl. 6, figs. 9, 12, 13;

pl. 7, figs. 1-5)

DERIVATION OF NAME. Latin, referring to shape of dorsal outline.

DIAGNOSIS. Paracypris with asymmetrically arched dorsal margin, straight ventral margin and low pointed posterior.

MATERIAL. 15 valves and carapaces.

HOLOTYPE. Carapace, OS 11565, Marnes de Port-en-Bessin, L. Bathonian, Port-en-Bessin, Normandy.

DESCRIPTION. Slender elongate carapace, rounded anteriorly, acuminate posteriorly. Dorsal margin asymmetrically arched with highest point in anterior third; posterodorsal slope tapers down to a narrow pointed posterior margin situated ventrally; cardinal angles rounded. Greatest length ventrally, greatest width just in front of mid-point. LV larger than RV which it overlaps on all sides except anteriorly where the valves are equal. Ventral margin more or less straight in both valves although in RV there is slight median concavity. Shell surface smooth.

Hinge is a simple groove in LV into which dorsal edge of RV fits. Inner margin and line of concrescence not coincident terminally, prominent vestibules being produced; anteriorly the vestibule is broad while posteriorly it is narrow. Radial pore canals numerous and may be seen to branch anteroventrally at least. Muscle scars a rounded rosette of many scars, precise number indeterminate.

DISTRIBUTION. Apart from the type locality and level P. asymmetrica also occurs in the Campagnettes Member, Upper Bathonian of Ranville Campagnettes Quarry, Normandy, and the U. Bathonian U. Fuller's Earth to Forest Marble of Winterborne Kingston borehole, S. England.

DIMENSIONS

			L	H	W	Locality
holotype,	car.,	OS 11565	.63	.23	.18	F-PB.6.78
paratypes:	car.,	OS 11566	.62	.24	.17	F-PB.6.78

Explanation of Plate 7

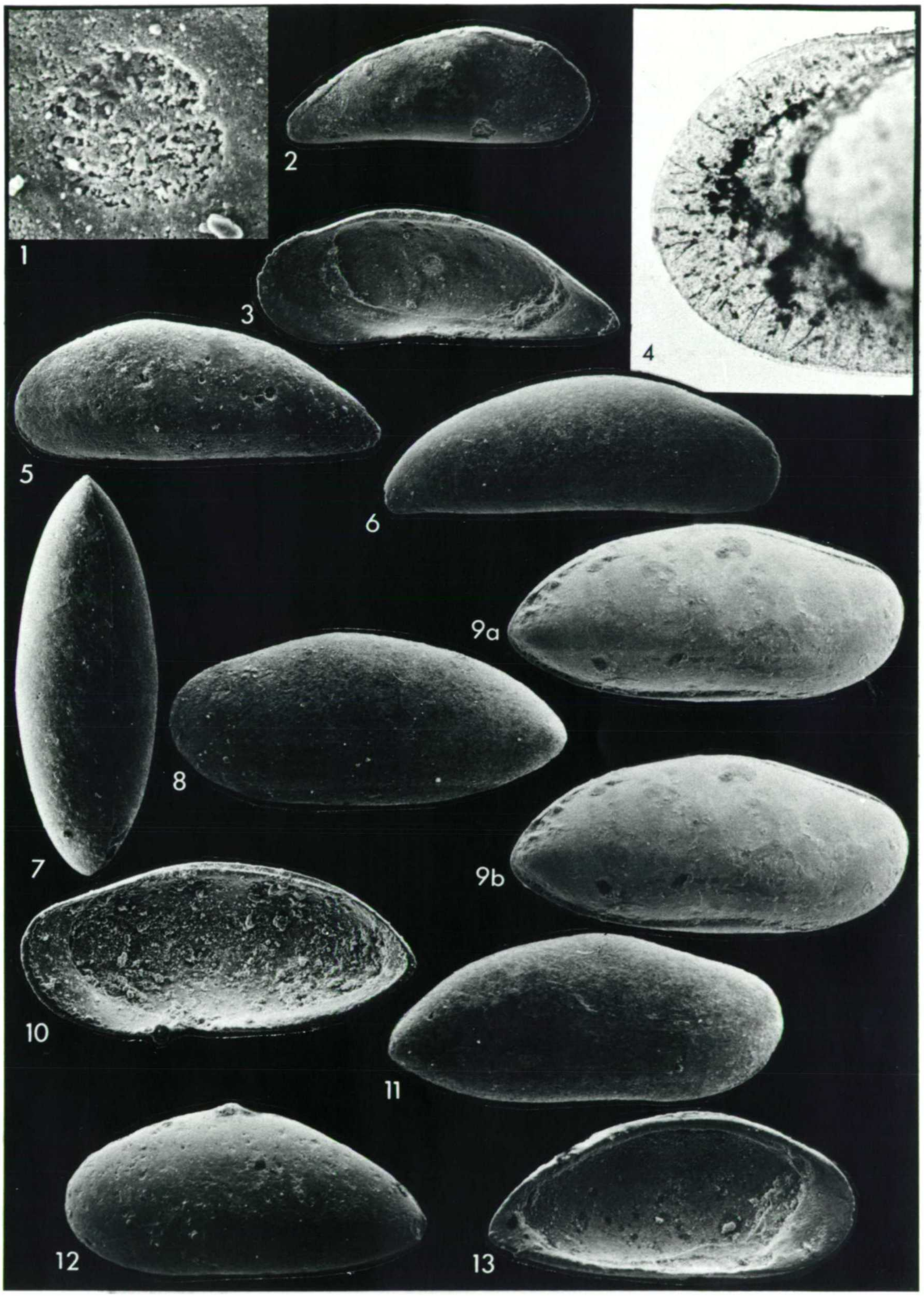
Figs. 1 - 5. Paracypris asymmetrica sp. nov.: figs. 1, 3, 4, RV, OS 11570 (.63 mm long): fig. 1, muscle scars (x 610); fig. 3, int. lat. (x 95); fig. 4, marginal pore canals (x 214), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, (F-PB.7.78); fig. 2, juv. car., R side, OS 11571 (.41 mm long, x 121), L. Bathonian, as above (F-PB.6.78); fig. 5, car., L side, OS 11566 (.62 mm long, x 96), L. Bathonian as above.

Fig. 6. Paracypris sp. 1, car., R side, OS 11572 (.68 mm long, x 95), L. Bathonian, as above (F-PB.35.78).

Figs. 7 - 11. Pontocyprella subaureola sp. nov.: figs. 7, 9, holotype, car., OS 11573 (.78 mm long, x 84): fig. 7, dors.; fig. 9, stereo-pair of R side, L. Bathonian, as above (F-PB.8.78); fig. 8, LV, OS 11575 (.79 mm long, x 83), L. Bathonian, as above; fig. 10, RV int., OS 11574 (.77 mm long, x 85), L. Bathonian, as above; fig. 11, RV, OS 11576 (.74 mm long, x 87), L. Bathonian, as above.

Figs. 12, 13. Pseudomacrocypris atypica sp. nov.: fig. 12, LV, MPA 5590-C3 (.41 mm long, x 146), U. Bathonian, U. Fuller's Earth, depth 210.93 - 211.40 m, Seabarn Farm, borehole; fig. 13, holotype, LV int., MPA 5590-C1, (.39 mm long, x 153), U. Bathonian, as above.

PLATE 7



		L	H	W	Locality
RV,	OS 11567	.62	.24		F-PB.6.78
car.,	OS 11568	.63	.25	.21	F-R.3A.78
RV,	OS 11569	.67	.27		F-PB.8.78
RV,	OS 11570	.63	.23		F-PB.7.78
juv. car.,	OS 11571	.41	.17	.12	F-PB.6.78

ECOLOGY. Marine, shallow water, inner shelf environment.

REMARKS. P. asymmetrica bears certain resemblances to several described Mesozoic species of the genus but is sufficiently different to be regarded without doubt as a valid new species. The Bathonian species P. terraefullonicae (Jones & Sherborn, 1888) described by Bate (1967) from E. England differs by being proportionally higher (average height of .29 mm to a length of .62 mm compared with .24 to .63 mm respectively in P. asymmetrica), and by being highest medially rather than anteriorly. The Bajocian form P. bajociana Bate (1963, 186, pl. 2, figs. 1-8) also from E. England is similarly higher, has prominent cardinal angles and does not taper to the posterior as markedly as in P. asymmetrica. The following represent those species which are considered the closest morphologically but from their illustrations and descriptions are clearly distinguishable from P. asymmetrica: P. projecta Peterson (1954, 163, pl. 17, figs. 14, 15) from the U. Jurassic of western U.S.A.; P. regularis Donze (1964, 115, pl. 2, figs. 41-43) from the L. Cretaceous of S.E. France; P. lubrica Lyubimova & Khabarova (1955, 24, pl. 1, figs. 5a, b) from the Russian Callovian of the Volga-Ural district; and P. sp. D Oertli (1959, 20, pl. 2, figs. 43, 44) from the Oxfordian of the Swiss Juras (recorded also by Plumhoff, 1963 from the Bajocian of N.W. Germany and by Neale, 1962 from the L. Cretaceous of N.E. England). It is possible that P. sp. D is phylogenetically linked to P. asymmetrica as it is widespread geographically and stratigraphically; the two species have very similar dimensions and proportions.

P. asymmetrica does not appear to be facies restricted, and is more tolerant of water depth changes than P. terraefullonicae, occurring in Normandy.

Paracypris terraefullonicae (Jones & Sherborn, 1888)

(Pl. 6, fig. 14)

1888 Macrocypris terrae-fullonicae Jones & Sherborn, 252, pl. 5, figs. 3a-c.

1967 Paracypris terraefullonica (Jones & Sherborn); Bate, 27, pl. 1, figs. 1-6.

1978 Paracypris terraefullonica (Jones & Sherborn); Pyatkova & Permyakova, 126, pl. 47, figs. 3a, b.

DIAGNOSIS. Paracypris with elongate carapace, posteriorly acuminate. Ventral margin almost straight in larger left valve, more strongly concave in right valve. Dorsal margin arched with anterodorsal slope slightly concave especially in right valve. Shell surface smooth.

MATERIAL. 21 valves and carapaces.

DESCRIPTION. See Bate, 1967.

DISTRIBUTION. Apart from the type locality at Midford, near Bath, Somerset, where it occurs within the U. Bathonian Blue Fuller's Earth Clay, P. terraefullonicae has been recorded from L. to U. Bathonian sediments within several boreholes near Bath and in Dorset (Bate, 1979, Bate and Sheppard, 1981). Outside western Europe it has been recorded in the Bathonian of the Ukraine (Pyatkova & Permyakova, 1978). Herein it is known only from L. to U. Bathonian sediments from boreholes within the Dorset Province.

ECOLOGY. Marine, shelf environment, preferring the finer grained clay sediments (relatively quiet waters).

REMARKS. The absence of P. terraefullonicae from the Bathonian of the Kent-Boulonnais Province and the Normandy Province suggests it to be relatively deep water form, inhabiting that area with best access to the open sea. A shelf environment, probably inner shelf, is proposed for this species, with occasional migration into shallower near-shore waters e.g. in the Forest Marble.

Paracypris sp. 1.

(Pl. 7, fig. 6)

REMARKS. A single specimen carapace of a very slender species of Paracypris occurred in the L. Bathonian Marnes de Port-en-Bessin. The dimensions (l = .68, h = .23, w = .18) make it a very characteristic form, distinguishable from known species of the genus, however it is unreasonable to propose a name on one specimen only and with no internal features.

Genus Pontocyprella Mandelstam, 1955

Pontocyprella subaureola sp. nov.

(Pl. 7, figs. 7-11; text fig. 5-2)

1973 Pontocyprella cf. aureola Ljubimova 1955; Dépêche, 224, pl. 3, figs. 1-7.

DERIVATION OF NAME. From sub = slightly + aureola, referring to the resemblance to P. aureola Ljubimova, 1955.

DIAGNOSIS. Pontocyprella with sinuous convex dorsal margin and distinct cardinal angles; low pointed posterior margin; shell surface smooth.

MATERIAL. 34 valves and carapaces.

HOLOTYPE. Carapace, OS 11573, Marnes de Port-en-Bessin, L. Bathonian, Port-en-Bessin, Normandy.

DESCRIPTION. Bean-shaped carapace with convex dorsal margin becoming slightly concave in front of anterior cardinal angle; ventral margin slightly convex in LV, slightly concave in centre in RV. Anterior margin rounded, posterior margin acuminate and positioned at about a third of the height of the carapace. Cardinal angles distinct but rounded; greatest height of carapace passes through anterior cardinal angle, greatest length in ventral third, greatest width medially. LV larger than RV which it overlaps along dorsal margin and central part of ventral margin.

Hinge adont with, in LV, a closed groove with a pronounced overhang above. RV hinge formed of knifelike valve edge. Muscle scars a group of four oval adductors. Inner margin and line of concrescence not coincident: very narrow vestibules produced anteriorly and posteriorly. Marginal zone broad anteriorly. Marginal pore canals numerous, straight and closely-spaced (fig. 5-2).

DISTRIBUTION. Apart from the type locality and level P. subaureola has only been found from the L. Fuller's Earth, L. Bathonian of Seabarn Farm borehole, Dorset.

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11573	.78	.35	.28	F-PB.8.78
paratypes:	RV,	OS 11574	.77	.31		"
	LV,	OS 11575	.79	.36		"
	RV,	OS 11576	.74	.34		"
	car.,	OS 11577	.66	.29	.18	F-PB.48.78
	LV,	OS 11578	.79	.34		F-PB.7.78
	juv. car.,	OS 11579	.63	.28		F-PB.5.78
	juv. RV,	OS 11580	.63	.28		F-PB.8.78

ECOLOGY. Shallow water marine, clay/marl facies.

REMARKS. This species is very close Ljubimovella's P. aureola from Callovian to Oxfordian sediments of the Volga/Ural district in the U.S.S.R. and appears to differ only in size, being considerably smaller (length .54 mm). Lack of photographs, however, and adequate description makes further comparison of the internal features somewhat tenuous. From the line drawings in Ljubimova, 1955 and in Pyatkova & Permyakova, 1978 (Oxfordian of the Ukraine) the overlap of the LV over the RV in P. aureola is stronger than in P. subaureola and the cardinal angles are very much less pronounced, giving the dorsal margin a uniformly arched outline.

P. cf. aureola of Dépêche is from the same L. Bathonian Marnes de Port-en-Bessin as the present material. Although it is identical to P. subaureola (material checked in Paris) Dépêche has chosen smaller, probably juvenile forms to illustrate her species (she states a size range of .55 - .61 mm in length).

Family MACROCYPRIDIDAE Müller, 1912

Genus Pseudomacrocypris Michelsen, 1975

REMARKS. Pseudomacrocypris was erected by Michelsen working on L. Jurassic ostracods from the Danish Embayment as a genus distinct from Macrocypris Brady, basing his distinctions on simpler hinge structure and muscle scar pattern (5-6 spots only). Pre-Tertiary Macrocypris-type ostracods tend to be found as carapaces and are often poorly preserved. The specimens described here are single valves but preservation is, however, poor. Pseudomacrocypris is a rare genus of the English Bathonian fauna, represented by only 1 species.

Pseudomacrocypris atypica sp. nov.

(Pl. 7, figs. 12,13; pl. 8, figs. 1, 2)

DERIVATION OF NAME. Latin, referring to the atypical reversed arrangement of the hinge elements.

DIAGNOSIS. Species of Pseudomacrocypris with straight ventral margin and convex dorsal margin, maximum height occurring anterior of mid-point. Rounded anterior margin and low acuminate posterior margin.

MATERIAL. 5 valves only.

HOLOTYPE. LV, MPA 5590-C1, base of U. Fuller's Earth, U. Bathonian (polonica Zone), Seabarn Farm borehole, depth 210.93-211.40 m, Dorset.

DESCRIPTION. In lateral view valves are subtriangular in outline with straight ventral margin and slightly asymmetrically arched dorsal margin. Greatest height occurs just anterior of mid-point, greatest length ventrally. Acuminate posterior margin situated ventrally; dorsal margin well rounded. Cardinal angles rounded and indistinct. Shell surface smooth.

Inner margin and line of concrescence not coincident, giving rise to prominent vestibules, particularly anteriorly. Tripartite hinge comprising, in RV, smooth undifferentiated median groove, and dentate terminal ridges. Muscle scars not observed. Selvage of RV projects prominently in centre of ventral margin; that of LV does to a lesser extent.

DISTRIBUTION. Known only from the type locality and level.

DIMENSIONS.

			L	H
holotype,	LV,	MPA 5590-C1	.39	.18
paratypes:	RV,	MPA 5590-C2	.38	.18
	LV,	MPA 5590-C3	.41	.18

ECOLOGY. Shallow water offshore marine.

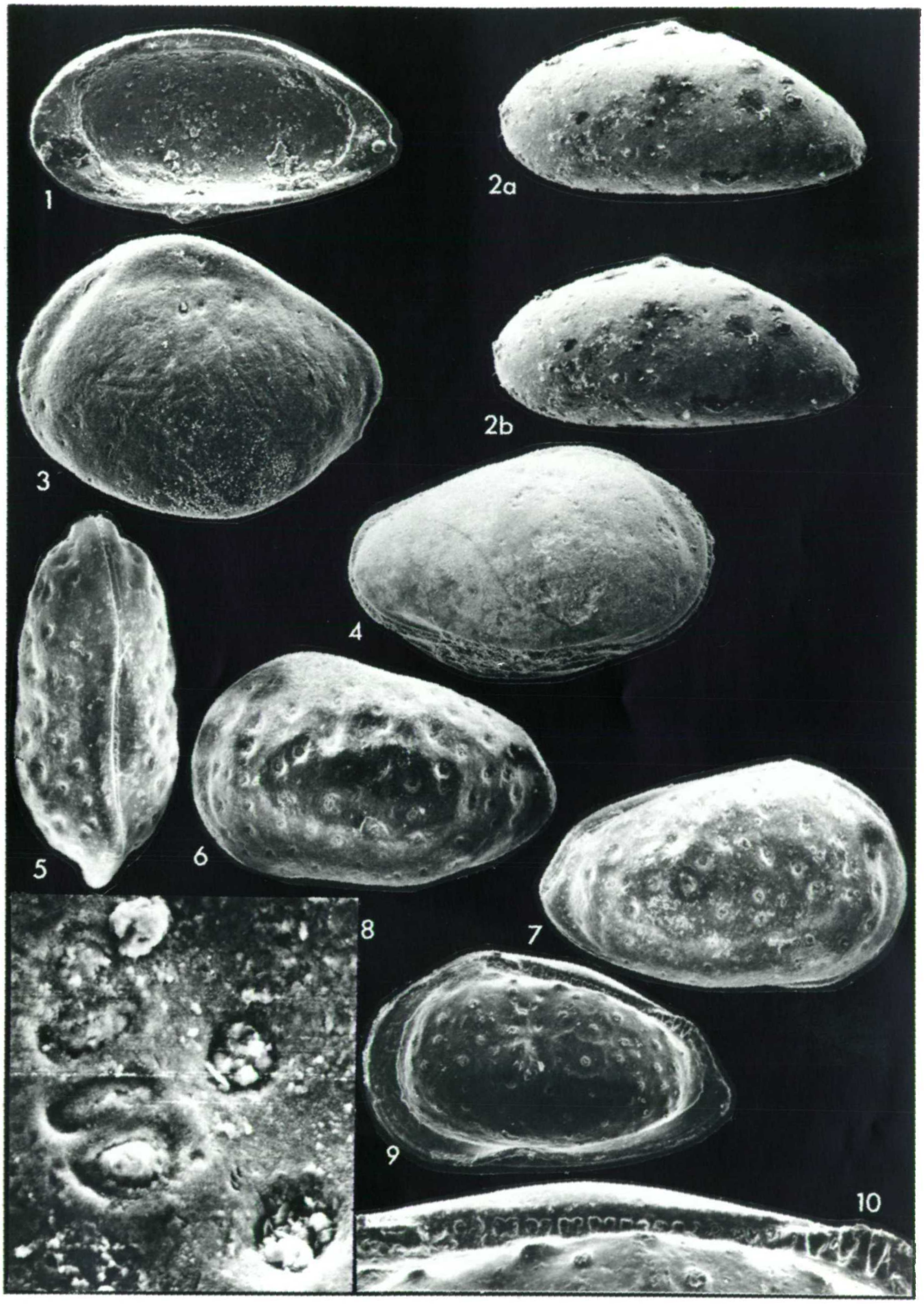
Explanation of Plate 8

Figs. 1, 2. Pseudomacrocypris atypica sp. nov.: fig. 1, RV int., MPA 5590-C2 (.38 mm long, x 157), U. Bathonian, U. Fuller's Earth, depth 210-93 - 211.40 m, Seabarn Farm borehole; fig. 2, stereo-pair of holotype, LV, MPA 5590-C1 (.39 mm long, x 153), U. Bathonian, as above.

Figs. 3, 4. Progonocythere stilla Sylvester-Bradley: fig. 3, ♀ LV, OS 11588 (.62 mm long, x 96), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.4.79); fig. 4, ♂ car., R side, OS 11589 (.68 mm long, x 88), U. Bathonian, as above.

Figs. 5 - 10. Strictocythere polonica (Blaszyk): fig. 5, ♀ car., dors., MPA 5558-C5 (.62 mm long, x 96), U. Bathonian, Frome Clay, depth 153.50 m, Seabarn Farm borehole; fig. 6, ♀ car., L side, MPA 5558-C6 (.60 mm long, x 100), U. Bathonian, as above; fig. 7, ♀ car., R side, MPK 2797 (.61 mm long, x 98), U. Bathonian as above; fig. 8, muscle scars of ♀ LV int., MPA 5558-C7 (x 850), U. Bathonian, as above; figs. 9, 10, ♀ RV, MPA 5558-C8 (.62 mm long): fig. 9, int. lat. (x 88), fig. 10, hinge (x 260).

PLATE 8



REMARKS. Although carapaces have not been found of this species it is likely that, with the greater ventral projection of the selvage, the RV is the larger valve. In other species of the genus and in species of the closely-related genus *Macrocypris* the hinge comprises a median groove and terminal ridges in the LV; in *P. atypica* these elements occur in the RV with the reverse on the LV. It is not knownwhy such reversal should occur; all other features conform to the generic morphology.

This is the first record of the genus in the English Bathonian. *P. atypica* is very similar to two described species, *P. subtriangularis* Michelsen and *P. subaequalis* Michelsen, both from the L. Jurassic of the Danish embayment, *P. subaequalis* having previously been recorded from the L. Aalenian of NW Germany (as *Macrocypris* (*M*) ?*aequabilis* Oertli, 1959 in Plumhoff, 1963). *P. subtriangularis* differs by being larger (holotype length = .49 mm) and having its greatest height passing through the anterior cardinal angle. *P. subaequabilis* is of similar dimensions to *P. atypica* but has a much more rounded, less acuminate, posterior margin and the greatest height occurs more anteriorly. *Macrocypris aequabilis* Oertli (1959, 24, pl. 3, figs. 74-82) from the U. Jurassic of the Swiss Juras, as distinct from Plumhoff's species, is perhaps the closest morphologically to *P. atypica.* It has the same dimensions but the greatest height of the carapace passes through the mid-point. Oertli's material included only complete carapaces; a comparison of the internal details is not, therefore, possible.

Superfamily Cytheracea Baird, 1845

Family PROGONOCYTHERIDAE Sylvester-Bradley, 1948

Subfamily PROGONOCYTHERINAE Sylvester- Bradley, 1948

Genus *Progonocythere* Sylvester-Bradley, 1948

DIAGNOSIS (emended). A rectangular genus of Progonocytherinae, often strongly dimorphic. Carapace tapering to blunt posterior, steep postero-ventral slope, dorsal margin sharply angled in female dimorph. Valves

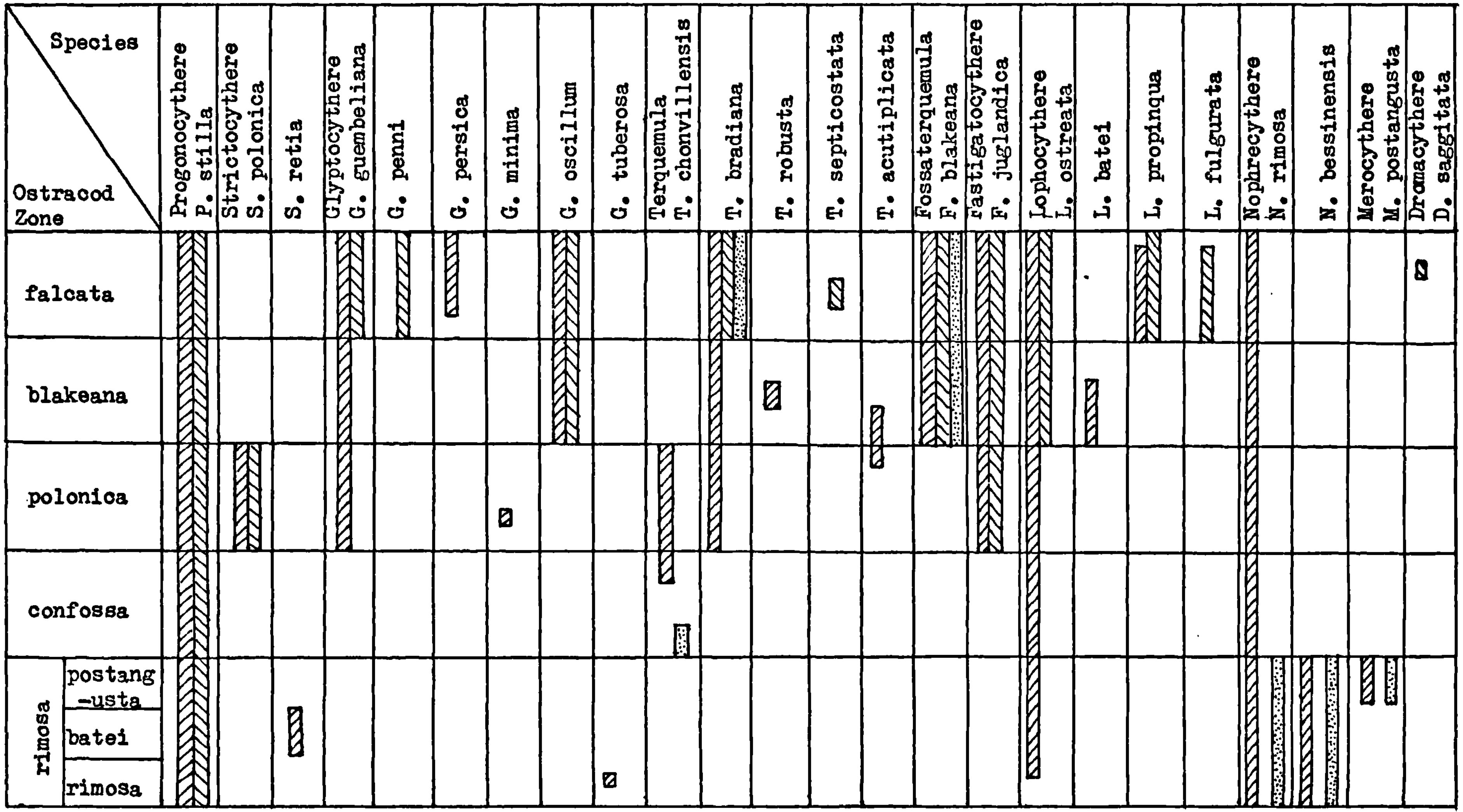


Table 5-4-1 Range table for members of the Progonocytheridae.

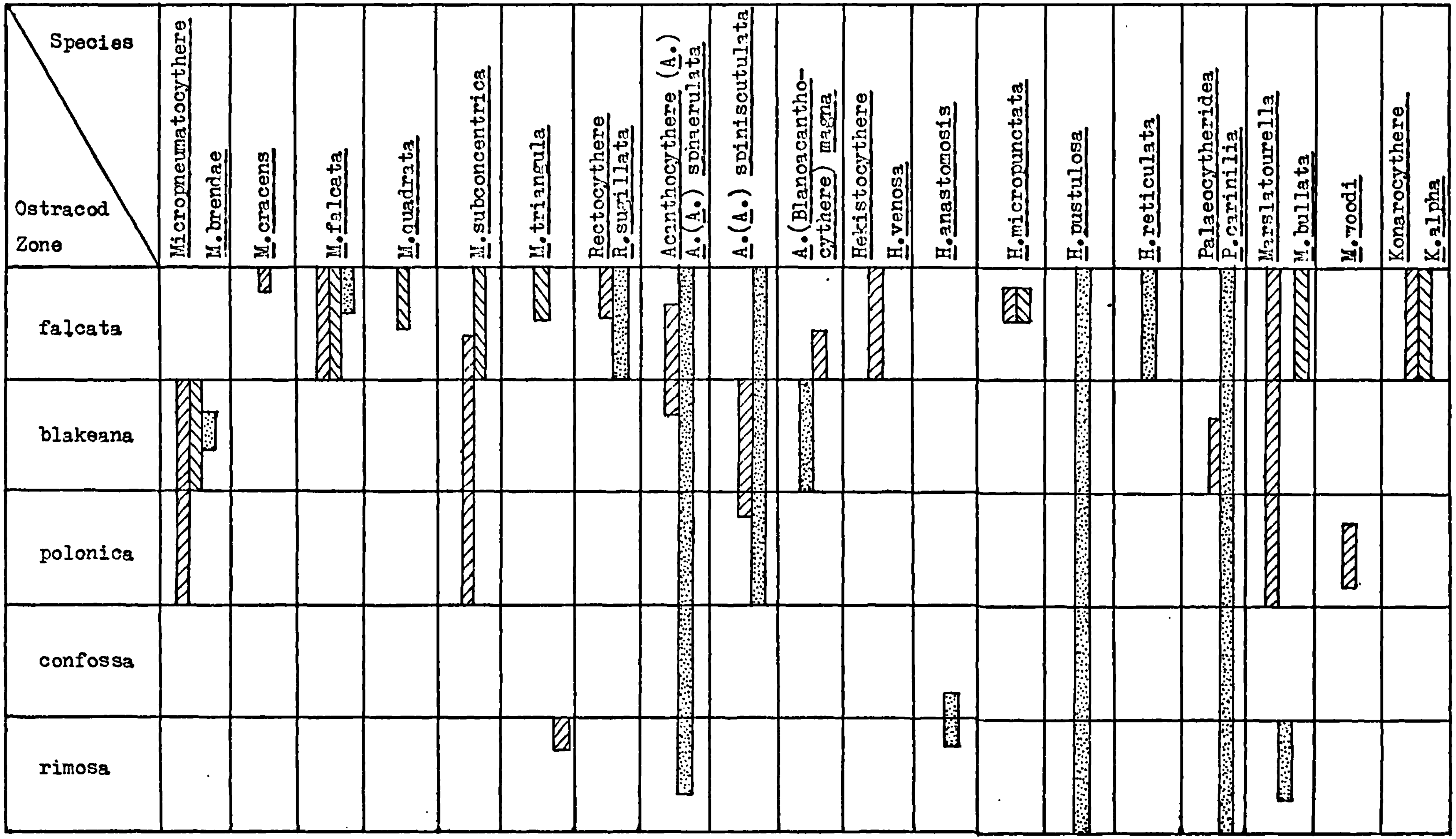


Table 5-4-2 Range table for members of the Progonocytheridae.

uniformly convex in dorsal view. Lateral border strongly overhanging ventral margin. Shell variously ornamented or smooth. Left valve larger than right. Hinge entomodont.

TYPE SPFCIES. Progonocythere stilla Sylvester-Bradley, 1948.

REMARKS. The genus Progonocythere has, in the past, been applied to many species possessing a rectangular outline, ventral overhang of the valves and an entomodont hinge. As a result the precise diagnosis based on the type-species, P. stilla, has become somewhat expanded to include forms which strictly speaking belong elsewhere. From the described species of European Jurassic progonocytherids the following represent those which belong to the genus as redefined and those originally placed in Progonocythere but lacking the distinct ventrolateral overhang, steep posteroventral slope and convex (in dorsal view) carapace and must therefore be removed from it.

Progonocythere sensu stricto	To be removed from genus
P. stilla Sylvester-Bradley, 1948	* P. polonica Blaszyk, 1959
P. cristata Bate, 1963	P.? posteriorhumilis Blaszyk, 1967
P. reticulata Bate, 1963	* P.? convexa Blaszyk, 1967
P. yonsnabensis Bate, 1965	P. levigata Bate, 1967
P. acuminata Bate, 1965	* P. callovica Wienholz, 1968
P. rugosa Bate, 1967	* P. praepolonica Dreyer, 1967
P. triquetra Bate, 1967	
P. parastilla Whatley, 1964	
P. multipunctata Whatley, 1964	

Of those species previously assigned to Progonocythere, but now removed from the genus, those marked (*) represent species assigned to the new genus Strictocythere. The remaining two species have yet to be assigned to new genera.

Progonocythere stilla Sylvester-Bradley, 1948

(Pl. 8, figs. 3, 4; text fig. 5-3)

1948 Progonocythere stilla Sylvester-Bradley, 190, pl. 12, figs. 1, 2; pl. 13, figs. 1, 2; text-figs. 1, 2.

1975 Progonocythere stilla Sylvester-Bradley; Mayes, 173, pl. 2, 174; pl. 2, 176; pl. 2, 178; pl. 2, 180.

1978 Progonocythere stilla Sylvester-Bradley; Bate, 230, pl. 3, fig. 1.

DIAGNOSIS. Finely punctate species of Progonocythere with inflated subquadrate carapace. Highest point in anterior third, dorsal margin tapering at about 40° to blunt posterior. Ventrolateral border of valves strongly overhanging ventral margin.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Sylvester-Bradley, 1948 and Mayes, 1975.

DISTRIBUTION. P. stilla is a long-ranging Bathonian species occurring throughout the stage in north eastern France and Dorset and Somerset of southern England (see Mayes, 1975 for locality details). It is recorded herein from L. to U. Bathonian sediments (rimosa to falcata Zones) of the Dorset and Kent-Boulonnais Provinces. It is not known from Normandy.

ECOLOGY. Marine, occurring in a variety of facies types, also tolerating some brackish water influence.

REMARKS. P. stilla, in being restricted to the Bathonian, is stratigraphically important only in determining beds to stage level; for a finer subdivision it is of no use.

Genus Strictocythere nov.

DERIVATION OF NAME. Latin strictus, straight, + cythere.

DIAGNOSIS. A genus of Progonocytherinae, elongate-oval in lateral outline, having well rounded anterior margin and small rounded triangular posterior margin with short caudal process. Valves straight-sided in dorsal view. Length to height ratio about 1.6:1. Shell surface variously ornamented by pitting. Ventrolateral border of valves slightly overhangs ventral margin. Hinge entomodont.

TYPE SPECIES. Strictocythere polonica (Blaszyk, 1959).

REMARKS. Strictocythere is here erected to accommodate those species previously assigned to Progonocythere but which lack the diagnostic rectangular shape, strong ventral overhang of valves and convexity in dorsal view. Included within Strictocythere are:

P. polonica Blaszyk, 1959

P. praepolonica Dreyer, 1967

P. ? convexa Blaszyk, 1967

P. callovica Wienholz, 1968

Strictocythere first appears in the Bajocian and ranges through into the Callovian. It is somewhat similar to the genera Glyptocythere Brand & Balz and Merocythere Oertli. Glyptocythere is more inflated in dorsal view, has generally more ovoid shape and the overlap of LV over RV is more pronounced. Merocythere is distinguished by its hemimerodont hinge type.

Strictocythere polonica (Blaszyk, 1959)

(Pl. 8, figs. 5 - 10; text fig. 5-3)

1959 Progonocythere polonica Blaszyk, 434, pl. 1, figs. 5a-f, pl. 2, figs. 5a-b; pl. 3; pl. 4, figs. 2a-b.

1959 Progonocythere ogrodzieniecensis Blaszyk, 440, pl. 4, figs. 1a-j; pl. 5.

1960 Ostracod nr. 9 Lutze, 415, pl. 38, fig. 6.

1978 Progonocythere polonica Blaszyk, Bate, 230, pl. 3, figs, 2 - 4.

DIAGNOSIS. Strictocythere with ovoid carapace, highest point in anterior quarter. Surface ornamented with very large evenly spaced subcircular normal pore canal openings as distinct pits. Sieve plates often present. Dimorphic.

MATERIAL. More than 100 valves and carapaces.

DESCRIPTION. See Blaszyk, 1959.

DISTRIBUTION. Previously recorded from L. to U. Bathonian of Poland (Blaszyk, 1959, 1967) and NW Germany (Lutze, 1960), and U. Bathonian (polonica ostracod Zone) at several locations in southern England (Bate, 1978, Sheppard, 1981) and Normandy (Sheppard, 1981). It is unknown from Kent-Boulonnais Province.

REMARKS. This species has been used (Sheppard, 1981) as the index ostracod for the Progonocythere polonica Zone, now consequently the Strictocythere

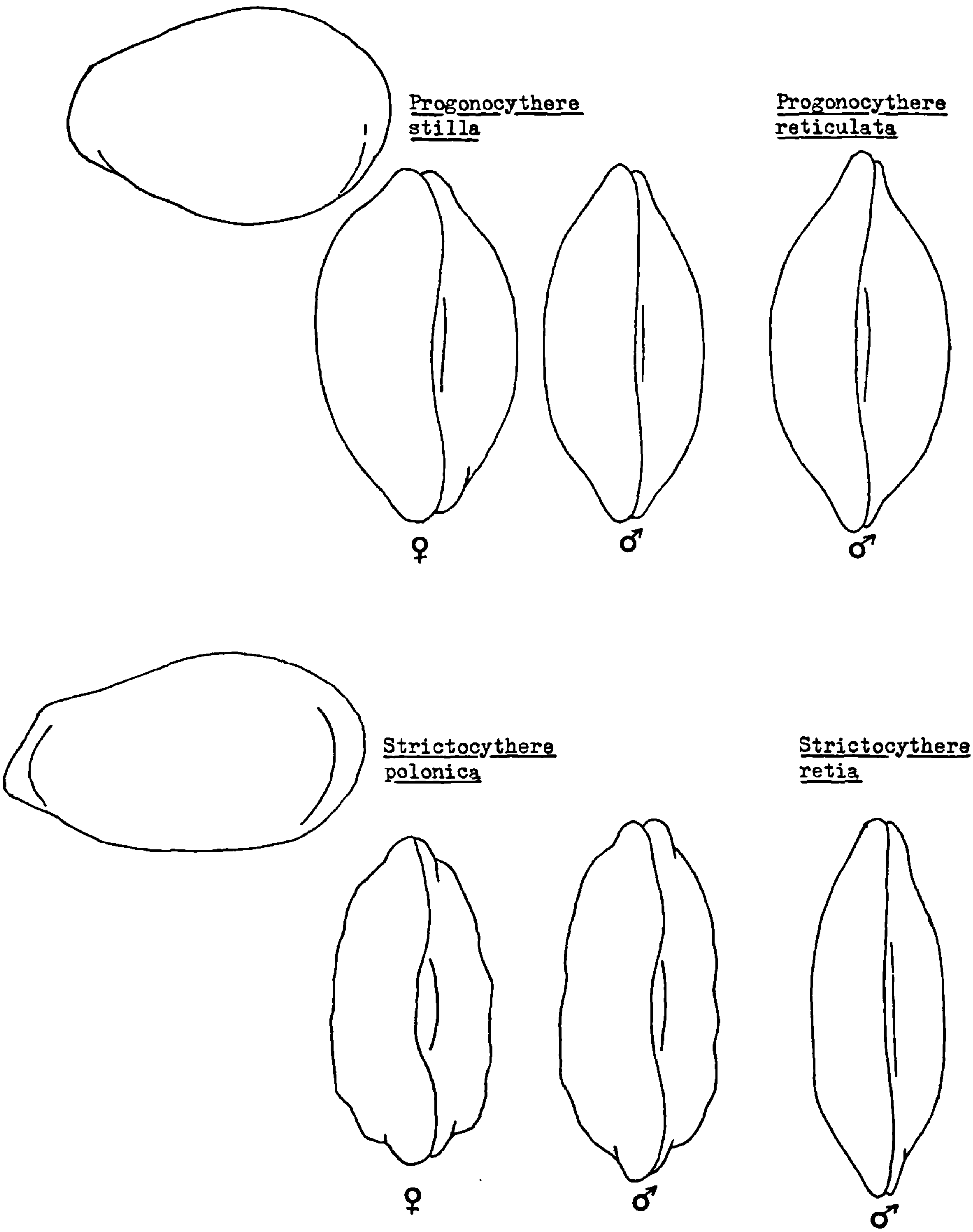


Figure 5-3 Comparison of Progonocythere and Strictocythere in dorsal view

polonica Zone, at the base of the U. Bathonian. It appears to be, in southern England and Normandy at least, restricted to that Zone, being replaced by Fossaterquemula blakeana (Jones) into which it evolves (see 'Remarks' section for that species), being the index ostracod of the overlying Zone. S. polonica was, however, first described from U. Bathonian beds in Poland of discus ammonite Zone age. Furthermore Blaszyk (1967) records it, again from Poland, from sediments of supposed L. and M. Bathonian. Assuming the age dating of these beds to be correct then the stratigraphical range of S. polonica is far greater in Poland than it is in southern England and Normandy, immediately implying that its use as a zonal index is no longer valid in Poland. This question of the geographic extent of the Zones is discussed fully in the Zonation chapter. What is inferred from this situation is that at some time, probably towards the close of the M. Bathonian, a general movement westwards was initiated by S. polonica from central Poland, across northern Germany and ultimately into the Paris Basin and surrounding regions, its appearance here marking the beginning of the U. Bathonian. Within this sedimentary basin the species flourished, speciation occurred, resulting in the evolution of a new genus Fossaterquemula, and then it became extinct. In poland, however, the species continued throughout the entire Bathonian but here conditions were evidently not suitable for such speciation as Fossaterquemula is not recorded. Evolution in a different direction occurred in this region, with S. convexa (Progonocythere convexa Blaszyk, 1957) appearing as an offshoot in the U. Bathonian, and possibly too S. callovica Wienholz, 1968 in the Callovian being derived from S. polonica stock.

In N Germany there is evidence of an ancestor to S. polonica in the form of S. praepolonica Dreyer, 1967 (not P. praepolonica of Dépêche, 1973) in the Bajocian. Neither this species, S. convexa nor S. callovica occur in the Paris Basin region. It is not the intention here to discuss in detail possible phylogenies occurring outside the study area, albeit to say that in S. polonica there is a complete divergence of development in the two geographic regions which are now NW and E Europe. This is shown on Table 5-5.

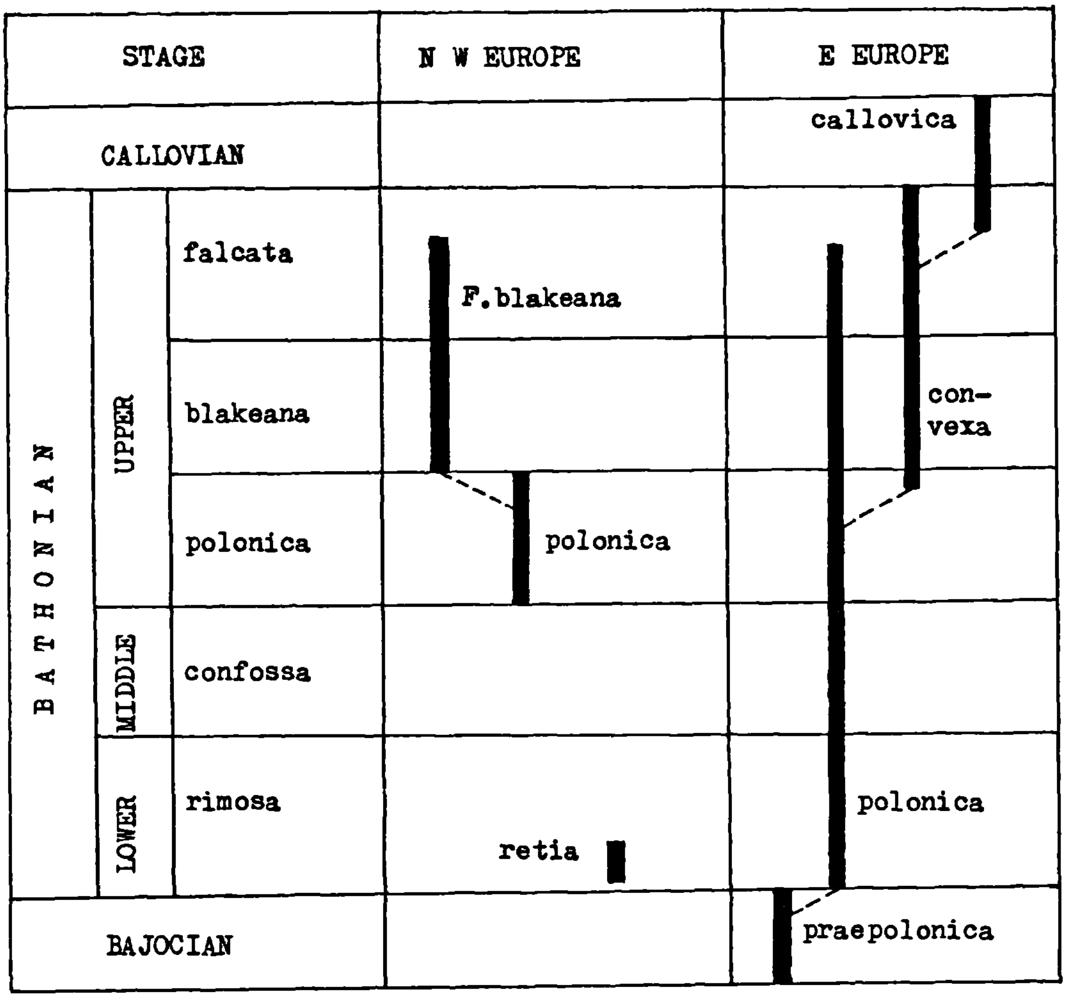


TABLE 5-5 Phylogenetic relationships of species of *Strictocythere* in Europe.

. Strictocythere retia sp. nov.

(Pl. 9, figs. 1-6; text fig. 5-3)

DERIVATION OF NAME. Latin, retia, 'net' pertaining to the surface ornament.

DIAGNOSIS. Strictocythere with surface ornamentation of closely spaced pits forming a coarse reticulation in central part of valve, pits being arranged in roughly concentric rings around this central part, becoming smaller towards valve periphery.

MATERIAL. 9 carapaces, 1 valve.

HOLOTYPE. Male carapace, MPA 6440-Cl, L. Bathonian, L. Fuller's Earth (rimosa Zone, batei Subzone), Seabarn Farm borehole, depth 345.74 - 346.73 m, Dorset Province.

DESCRIPTION. Elongate-oval carapace with greatest height passing through anterior cardinal angle, greatest length medially and greatest width just posterior of mid-point. Dorsal margin straight, with pronounced cardinal angles, sloping gently to triangular caudal process. Anterior margin broadly rounded; both this and posterior margin are terminally smooth and compressed. Ventrolateral part of valves slightly overhangs ventral margin. LV larger than RV which it overreaches on all sides. Surface ornamentation as diagnosed, a slight mid-lateral depression is present on both valves when viewed dorsally.

Hinge is entomodont with 8 terminal teeth anteriorly and 7 posteriorly in RV. Muscle scars and marginal pore canals have not been observed.

DIMENSIONS

			L	H	W	Depth (m)
holotype,	♂ car.,	MPA 6440-Cl	.73	.36	.33	345.74 - 346.73
paratypes:	♀ RV,	MPA 6440-C2	.63	.34		" "
	♂ car.,	MPA 6440-C3	.68	.36	.32	" "
	♀ car.,	MPA 6250-Cl	.63	.38	.34	336.00
	♀ car.,	MPA 6440-C4	.63	.36	.32	345.74 - 346.73

DISTRIBUTION. Known only from the batei Subzone of the type locality, occurring at a depth of between 336.00 m and 353.55 m, and of the Winterborne Kingston borehole, depth 886.27 - 887.26 m.

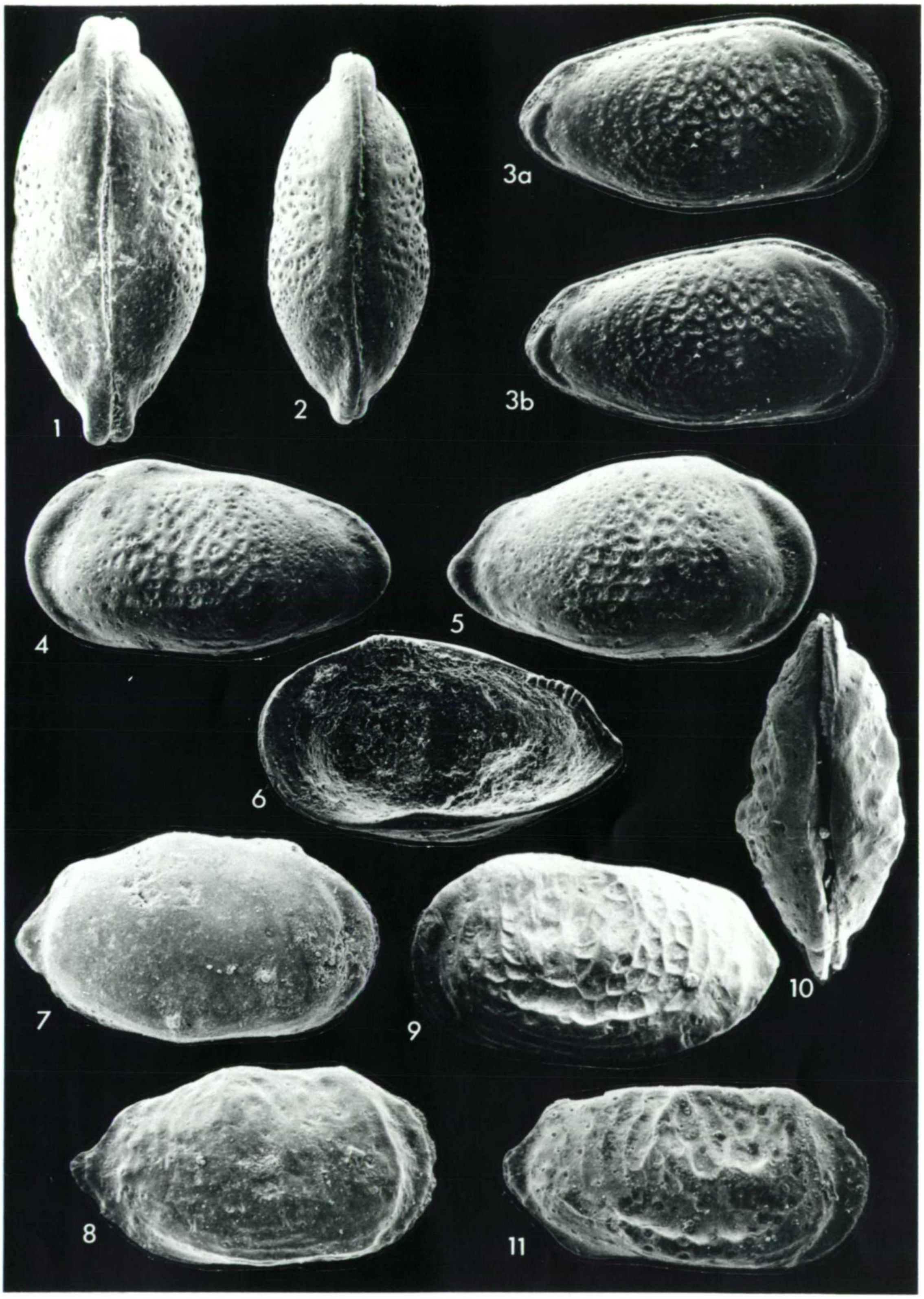
Explanation of Plate 9

Figs. 1 - 6. Strictocythere retia sp. nov.: fig. 1, ♀ car., vent., MPA 6250-C1 (.63 mm long, x 111), L. Bathonian, L. Fuller's Earth, depth 336.00 m, Seabarn Farm borehole; figs. 2, 4, ♂ car., MPA 6440-C3 (.68 mm long, x 88): fig. 2, dors.; fig. 4, L side, L. Bathonian, as above, depth 345.74 - 346.73 m; fig. 3, stereo-pair of holotype, ♂ car., R side, MPA 6440-C1 (.73 mm long, x 82), L. Bathonian, as above; fig. 5, ♀ car., R side, MPA 6440-C4 (.63 mm long, x 95), L. Bathonian as above; fig. 6, ♀ RV, int., MPA 6440-C2 (.63 mm long, x 95), L. Bathonian as above.

Figs. 7, 8. Glyptocythere guembeliana (Jones): fig. 7, ♀ RV, L 2775-C1 (.64 mm long, x 93), U. Bathonian, Forest Marble, depth 1290 ft., Fredville borehole; fig. 8, ♀ RV, JM 1688-C3 (.74 mm long, x 81), U. Bathonian, Forest Marble, Bobbing borehole.

Figs. 9 - 11. Glyptocythere penni Bate & Mayes: figs. 9, 10, ♀ car., JM 5514-C6 (.66 mm long, x 90): fig. 9, L side; fig. 10, dors., U. Bathonian, L. Cornbrash, St. Margaret's Bay borehole; fig. 11, ♂ RV, MPA 5514-C1 (.74 mm long, x 81), U. Bathonian, as above.

PLATE 9



ECOLOGY. Marine, shelf environment, as yet found only in clay facies.
REMARKS. This is the earliest record of the genus to date in the English Bathonian, appearing to be restricted to the batei Subzone of the rimosa Zone. In its shape and pattern of ornamentation, S. retia resembles Progonocythere reticulata Bate, 1963 from the English Bajocian and Merocythere postangusta Sheppard, 1981, index species for the postangusta Subzone lying immediately above the batei Subzone in the Normandy and Dorset Provinces. In P. reticulata the ornamentation comprises fewer, much larger pits. It has a stronger ventrolateral overhang, a steeper posteroventral slope and, in dorsal view, is much more evenly convex. Strictocythere, as a genus, is closely related to Progonocythere. It is possible that S. retia is derived from P. reticulata stock, the generic evolution taking place sometime during early Bathonian times although there is no direct evidence to support this as yet. With the existence of a Bajocian species of Strictocythere in Germany, however, in the form of S. praepolonica Dreyer, 1967, evolution of the genus there occurred much earlier, implying a westerly migration of the original Progonocythere stock along the W-E epicontinental sea existing at that time, into the northern Paris Basin area.

M. postangusta is distinguished from S. retia by being smaller (♀ length .47 - .55 mm), having a smaller length : height ratio, and in the possession of a hemimerodont hinge. The general carapace shape of the two species is similar but the surface pits in M. postangusta are fewer in number and more widely spaced.

Genus Glyptocythere Brand & Malz, 1962

Glyptocythere guembeliana (Jones, 1884)

(Pl. 9, figs. 7, 8)

1884 Cythere guembeliana Jones, 772, pl. 34, figs. 32, 33.

1888 Cythere pulvinar Jones & Sherborn, 266, pl. 3, figs. 2a-c.

1967 Glyptocythere guembeliana (Jones); Bate, 49, pl. 13, figs. 10 - 16; pl. 14, figs. 1 - 8.

1969 Glyptocythere guembeliana (Jones); Bate, 388, pl. 3, figs. 1, 2; pl. 4, fig. 1.

DIAGNOSIS. Carapace subquadrate, elongate in male dimorphic. Shell surface smooth with weakly developed transverse ridges extending down from dorsal margin. Ventrolateral margin evenly convex in female, sharply directed upwards posteriorly in male right valve. Hinge weakly entomodont.

MATERIAL. 35 valves and carapaces.

DESCRIPTION. See Bate, 1967.

DISTRIBUTION. Recorded previously from the U. Bathonian Great Oolite of the Richmond boring, Surrey (type locality), the U. Bathonian Blue Fuller's Earth Clay at Bath, and the U. Estuarine Series from Northamptonshire (Bate, 1967). It is recorded here from the U. Bathonian (falcata Zone) of the Kent-Boulonnais Province and U. Bathonian (polonica to falcata Zones) at several localities in the Dorset Province.

ECOLOGY. Shallow water marine, occurring within both littoral and sub-littoral lower energy environments.

REMARKS. It has been suggested (Bate, 1978, 230) that a possible phylogenetic lineage could lead from G. guembeliana, through G. oscillum to G. penni. The stratigraphic positioning of these species certainly supports such a view with G. guembeliana as the smooth form appearing first.

Glyptocythere penni Bate & Mayes 1977

(Pl. 9, figs. 9 - 11)

1977 Glyptocythere penni Bate & Mayes, 33, pl. 4, 34; pl. 4, 36; pl. 4, 38; pl. 4, 40.

DIAGNOSIS. Glyptocythere with coarsely rugose and reticulate ornamentation, two median swellings and pinched out ventrolateral border.

MATERIAL. 5 valves and 4 carapaces

DESCRIPTION. See Bate & Mayes, 1977.

DISTRIBUTION. An U. Bathonian ostracod, originally described from the Fimbriata-Waltoni Clay of Oxfordshire. It is here recorded from the falcata Zone of several borehole sections within the Kent-Boulonnais Province only. It appears to be restricted to a marginal marine environment bordering land and does not stray into the rather deeper waters further SW.

ECOLOGY. Shallow-water marginal marine, probably littoral, tolerating some brackish-water influence.

REMARKS. This is an interesting species as precocious sexual diamorphism has been recognised in it (Whatley & Stephens, 1977), although the specimens within the study material were too few in number to observe this. There is, however, evidence here to suggest a phylogenetic lineage from G. guembeliana which shows similar precocious dimorphism, with G. oscillum as a possible intermediate state. In the Kent Coalfield material occurs G. guembeliana in association with specimens of G. penni which show highly variable degrees of ornamentation from the typically rugose, reticulate form to one in which the lateral swellings and reticulation are barely noticeable (compare pl. 9, figs. 8 and 11).

Glyptocythere persica (Jones & Sherborn, 1888)

(Pl. 10, fig. 1)

1888 Cytheridea persica Jones & Sherborn, 270, pl. 4, fig. 4.

1969 Glyptocythere persica (Jones & Sherborn); Bate, 415, pl. 12, fig. 1.

1979 Glyptocythere persica (Jones & Sherborn); Bate, fig. 5.

DIAGNOSIS. Carapace with broad dorsomedian depression in anterior half; short, blade-like keel on ventral surface and ventrolateral margin develops into keel-like ridge. Lateral surface reticulate. Anterior and posterior marginal borders smooth, compressed.

MATERIAL. 2 valves.

DESCRIPTION. See Bate, 1969.

DISTRIBUTION. This species has previously been known only from the Bath area; U. Bathonian Blue Fuller's Earth (type locality) and U. Bathonian (polonica to blakeana Zones) U. Fuller's Earth (Bate, 1979). Herein it occurs only within the Forest Marble (falcata Zone) of the Seabarn Farm borehole, Dorset.

ECOLOGY. Shallow water marine, clay/marl facies.

REMARKS. G. persica is a particularly rare member of the U. Bathonian fauna.

Explanation of Plate 10

Fig. 1. Glyptocythere persica (Jones & Sherborn), ♀ RV (specimen lost), U. Bathonian, Forest Marble, Seabarn Farm borehole.

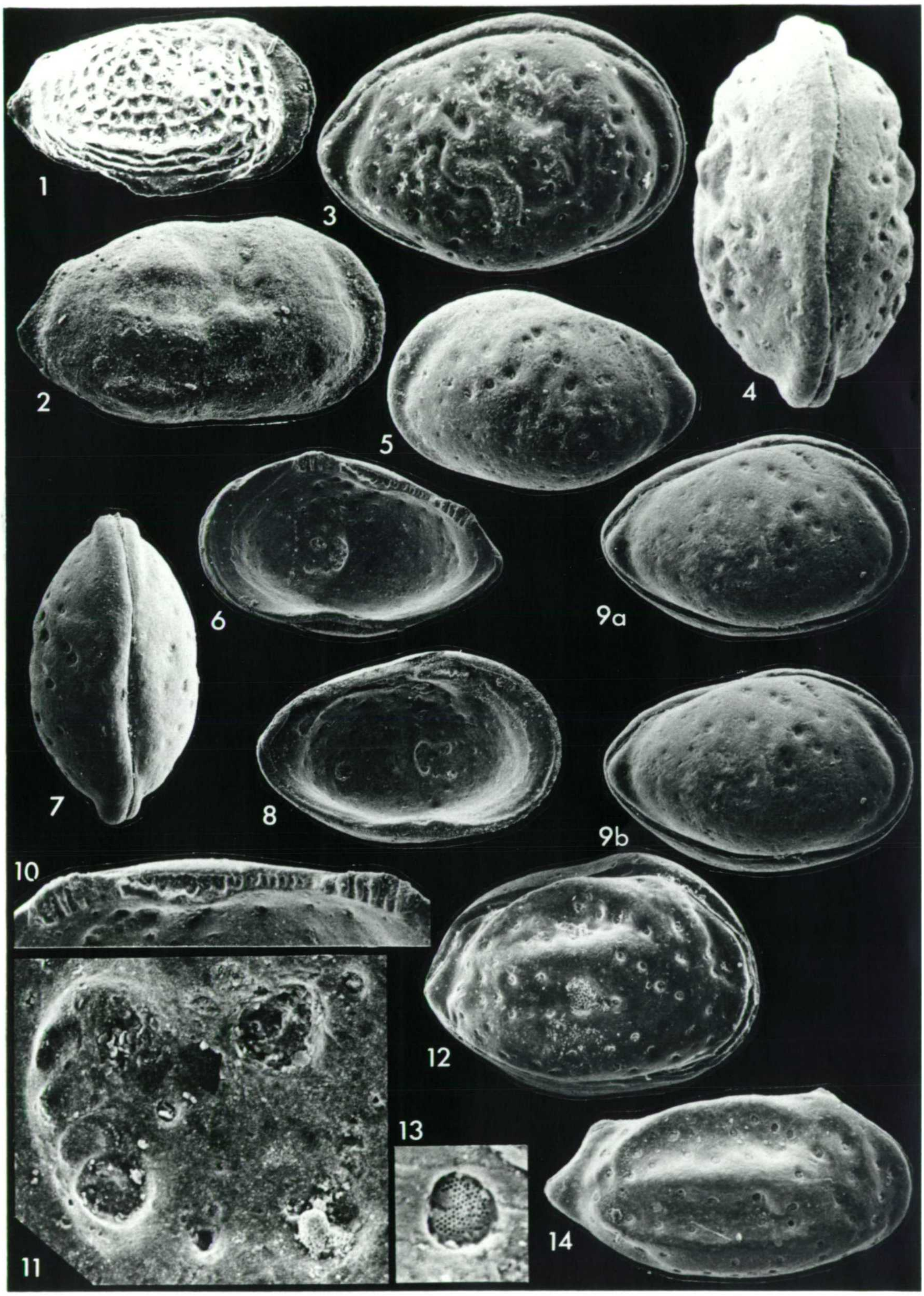
Fig. 2. Glyptocythere oscillum (Jones & Sherborn), ♀ RV, OS 11594 (.55 mm long, x 109), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.4.79).

Figs. 3, 4. Glyptocythere tuberosa Brand & Malz, ♀ car., MPA 6177-C1 (.57 mm long, x 105): fig. 3, R side; fig. 4, dors., L. Bathonian, L. Fuller's Earth, depth 300.5 m, Seabarn Farm borehole.

Figs. 5 - 11. Glyptocythere minima sp. nov.: figs. 5, 8, 11, ♀ LV, MPA 5999-C2 (.49 mm long): fig. 5, ext. lat. (x 102); fig. 8, int. lat. (x 102); fig. 11, muscle scars (x 720); figs. 6, 10, ♀ RV, MPA 5999-C4 (.47 mm long): fig. 6, int. lat. (x 106) fig. 10, hinge (x 300); fig. 7, ♀ car., dors., MPA 5999-C3 (.47 mm long, x 106); fig. 9, stereo-pair of holotype, ♀ car., R side, MPA 5999-C1 (.48 mm long, x 104). All are from U. Bathonian, Fuller's Earth Rock equivalent, depth 213.00 m, Seabarn Farm borehole.

Figs. 12-14. Terquemula chonvillensis (Dépêche): fig. 12, ♀ car., R side, MPA 5999-C7 (.53 mm long, x 103), U. Bathonian, as above; figs. 13, 14, ♂ RV, SAZ 1080-C1 (.60 mm long): fig. 13, normal pore canal opening with sieve plate (x 1K); fig. 14, ext. lat. (x 100), U. Bathonian, Frome Clay, depth 11.5 - 12.00 m, Lyme Bay borehole 74/35.

PLATE 10



Glyptocythere minima sp. nov.

(Pl. 10, figs. 5 -11)

DERIVATION OF NAME. Latin, small.

DIAGNOSIS. Small oval species of *Glyptocythere* with few irregularly spaced circular normal pore canal openings as large pits over lateral surface. Smooth, flattened anterior and posterior marginal areas. Left valve considerably larger than right.

MATERIAL. 11 valves and carapaces.

HOLOTYPE. Female carapace, MPA 5999-C1, Fuller's Earth Rock equivalent, U. Bathonian (*polonica* Zone), Seabarn Farm borehole, depth 213.00 m, Dorset.

DESCRIPTION. Small thick-shelled carapace, length .47 - .50 mm with greatest height passing through anterior cardinal angle, greatest length and width medially. Surface ornamented by large irregularly spaced normal pore canal openings, becoming smaller towards valve periphery. Valves uniformly convex in dorsal view. LV larger than, and overlapping, RV on all sides except extreme anterior.

Hinge strongly entomodont. Muscle scars as for genus.

DISTRIBUTION. Known only from the type locality and level.

DIMENSIONS.

				L	H	W
holotype,	♀	car.,	MPA 5999-C1	.48	.29	.26
paratypes:	♀	LV,	MPA 5999-C2	.49	.30	
	♀	car.,	MPA 5999-C3	.47	.29	.26
	♀	RV,	MPA 5999-C4	.47	.25	
	♀	car.,	MPA 5999-C5	.50	.31	.27

ECOLOGY. Marine, clay facies.

REMARKS. This is easily distinguished from other species of *Glyptocythere* on its small size and lack of highly ornate sculpturing which is common to many species. *G. minima* is found in association with *Strictocythere polonica* and, having a similar arrangement of surface pits, is very similar morphologically to juveniles of this species. It is distinguished, however, by having a much stronger overlap of the LV over the RV and by the posteroventral margin sloping steeply up to the posterior margin. In addition the well-developed entomodont hinge is a typically 'adult' structure and would not be found in juvenile stages.

Glyptocythere oscillum (Jones & Sherborn, 1888)

(Pl. 10, fig. 2)

1888 Cythere oscillum Jones & Sherborn, 254, pl. 3, figs. 8a-c.

1969 Glyptocythere oscillum (Jones & Sherborn); Bate, 412, pl. 5, figs. 2, pl. 12, fig. 2.

1977 Glyptocythere oscillum (Jones & Sherborn); Sheppard, 91 - 94.

DIAGNOSIS. Species of Glyptocythere with carapace strongly ornamented by two lateral grooves which are joined by a narrow vertical groove passing between two irregular swollen areas. A broad dorsomedian sulcus extends down to median groove. Normal pore canal openings prominently displayed over carapace.

MATERIAL. 73 valves and carapaces.

DESCRIPTION. See Bate, 1969 and Sheppard, 1977.

DISTRIBUTION. A widely distributed species within U. Bathonian sediments of southern England, G. oscillum has been recorded from the Bath area within several subsurface sections (Sheppard, 1977) and from Oxfordshire. It is here recorded from the U. Bathonian of the Kent-Boulonnais Province and the Dorset Province. It occurs within the blakeana and falcata Zones and was used originally by Bate (1978) as index ostracod for his Zone 5. Fossaterquemula blakeana (Jones, 1884) is, however, now preferred as index species because of its more extensive geographical distribution. G. oscillum is unknown from Normandy.

ECOLOGY. A marine species occurring within sublittoral environments.

Glyptocythere tuberosa Brand & Malz, 1962

(Pl. 10, figs. 3, 4)

1962 Glyptocythere hieroglyphica tuberosa Brand & Malz, 144, pl. 19, figs. 3, 4; pl. 21, figs. 18, 19.

1966 Glyptocythere tuberosa Brand & Malz, 507, pl. 57, figs. 58 - 69.

DIAGNOSIS. Glyptocythere with surface ornamentation of wrinkles; a central irregular swelling with minor swellings radiating from this.
MATERIAL. 1 carapace only.
DESCRIPTION. See Brand & Malz, 1966.
DISTRIBUTION. Recorded, by Brand & Malz, from the L. Bathonian of several localities in NW Germany.
REMARKS. This is the first occurrence of G. tuberosa outside Germany; indeed it is the first English occurrence of any of the Brand and Malz species of Glyptocythere. Although, in the material examined, only one specimen, a female carapace, was recovered, its presence in the Dorset Province is immediately of stratigraphic importance in linking the German horizons with that of southern England. Identification of the single specimen was aided by the examination of type-material supplied by Dr. H. Malz.

Genus Terquemula Blaszyk & Malz, 1965

1948 Lophocythere Sylvester-Bradley (pars)
1969 Paralophocythere Dépêche
1970 Neurocythere Whatley

REMARKS. First described from the U. Bathonian of central Poland, Terquemula is well represented in the M. and U. Bathonian sediments of southern England and, to a lesser extent, of northern France. Since its inception in 1965 it has had several species from other genera assigned to it, in particular from the group of species originally under Lophocythere, termed by Bate (1969) the 'bradiana' group. Ornamentation in all species of Terquemula comprises lateral ridges but some are reticulate between the ridges whereas others are smooth. Within the material studied there appears to be two parallel phylogenetic lineages which result in very similar patterns of ornamentation. These are shown on the range Table, table 5-5. T. chonvillensis (Dépêche) on the one hand gives rise to the typical 'bradiana' type of ribbing with reticulation whereas T. septicostata (Bate)

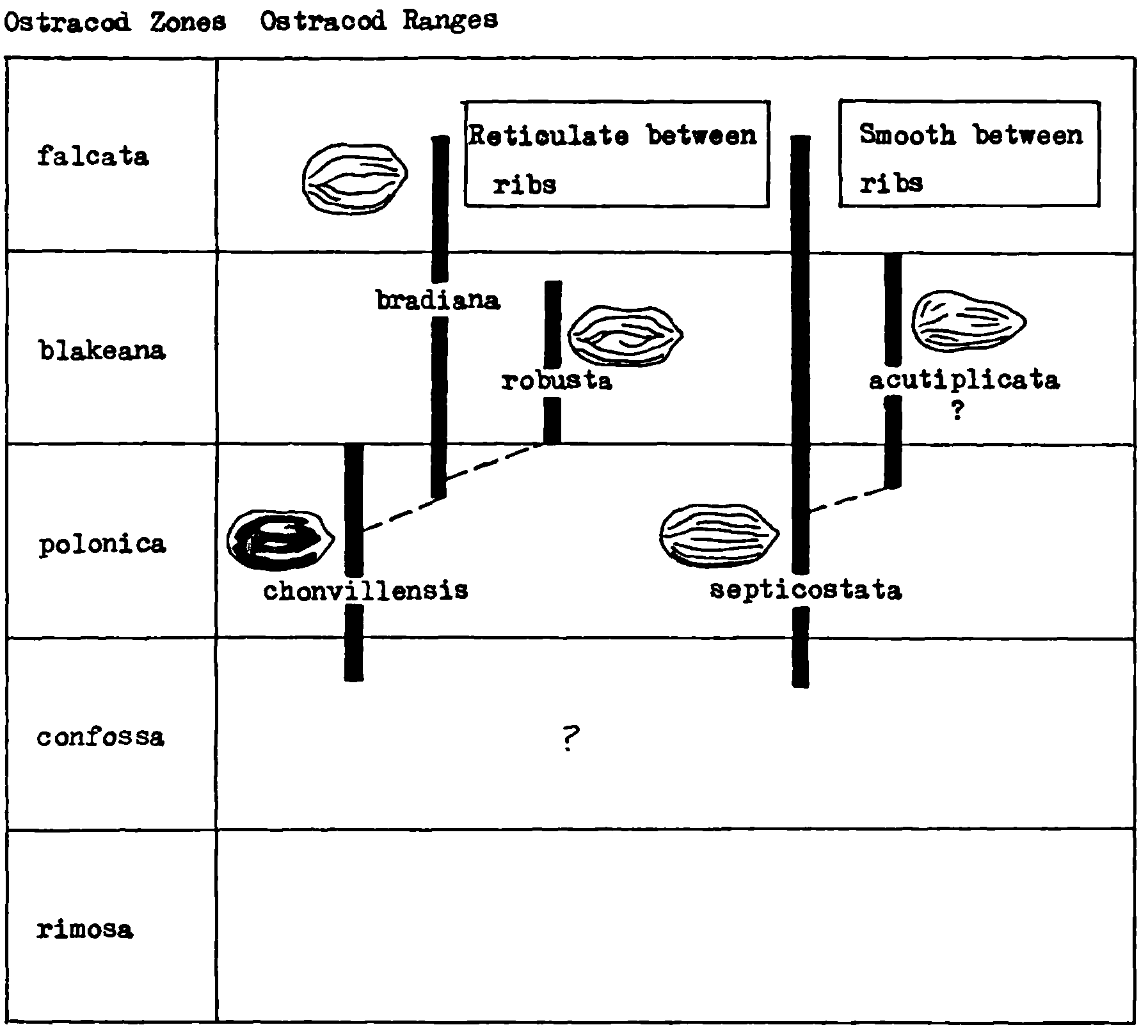


Table 5-6 Proposed phylogenetic relationships of species of <u>Terquemula</u>.

on the other has the already well-developed ribbing pattern without reticulation. The latter does not appear to change throughout its range, though it possibly gives rise to T. acutiplicata (Jones & Sherborn). The ancestor of both T. chonvillensis and T. septicostata is not known; indeed nothing in the present material has been found within the lower part of the Bathonian which could fit this rôle. The U. Callovian reticulate species T. flexicosta lutzei (Whatley, 1970) from England and Scotland is possibly derived from T. bradiana stock.

Terquemula chonvillensis (Dépêche, 1969)

(Pl. 10, figs. 12 -14; pl. 11, figs. 1, 2; text-fig. 5-4)

1969 Paralophyocythere chonvillensis Dépêche, 269, pl. 1, figs. 1 - 7.

1978 Terquemula bradiana (Jones) morphotype B; Bate, 246, pl. 11, figs. 6, 7.

1981 Paralophocythere chonvillensis Dépêche; Sheppard, pl. 2, fig. 1.

DIAGNOSIS (emended). Terquemula with three to four broad lateral ridges converging posteriorly, anteriorly dissolved into a loose reticulate network variously developed between specimens. A further short rib has a tendency to develop between dorsal and median ridges, in a posterior position. Large normal pore canal openings, with sieve-plates, scattered over lateral surface.

MATERIAL. 79 valves and carapaces.

DISTRIBUTION. Recorded, as Paraloph^ocythere chonvillensis, from U. Bathonian of the Chonville 1 borehole, Lorraine, eastern France (Dépêche, 1969) and the M. Bathonian topmost Marnes de Port-en-Bessin, Normandy (Sheppard, 1981). As T. bradiana morphotype B it has been recorded from the Bath area of southern England (Bate, 1978). It is further recorded here from M. to U. Bathonian (confossa to polonica Zones) within several borehole sections of the Dorset Province.

REMARKS. This species was originally assigned, by Dépêche, 1969, to the monospecific genus Paralophocythere, the diagnostic generic as well as specific features being the three broad lateral ridges, smooth eye node and entomodont hinge. Study of the present material has shown that a good deal of intra-specific variation exists with, commonly, the lower-most ridge

Explanation of Plate 11

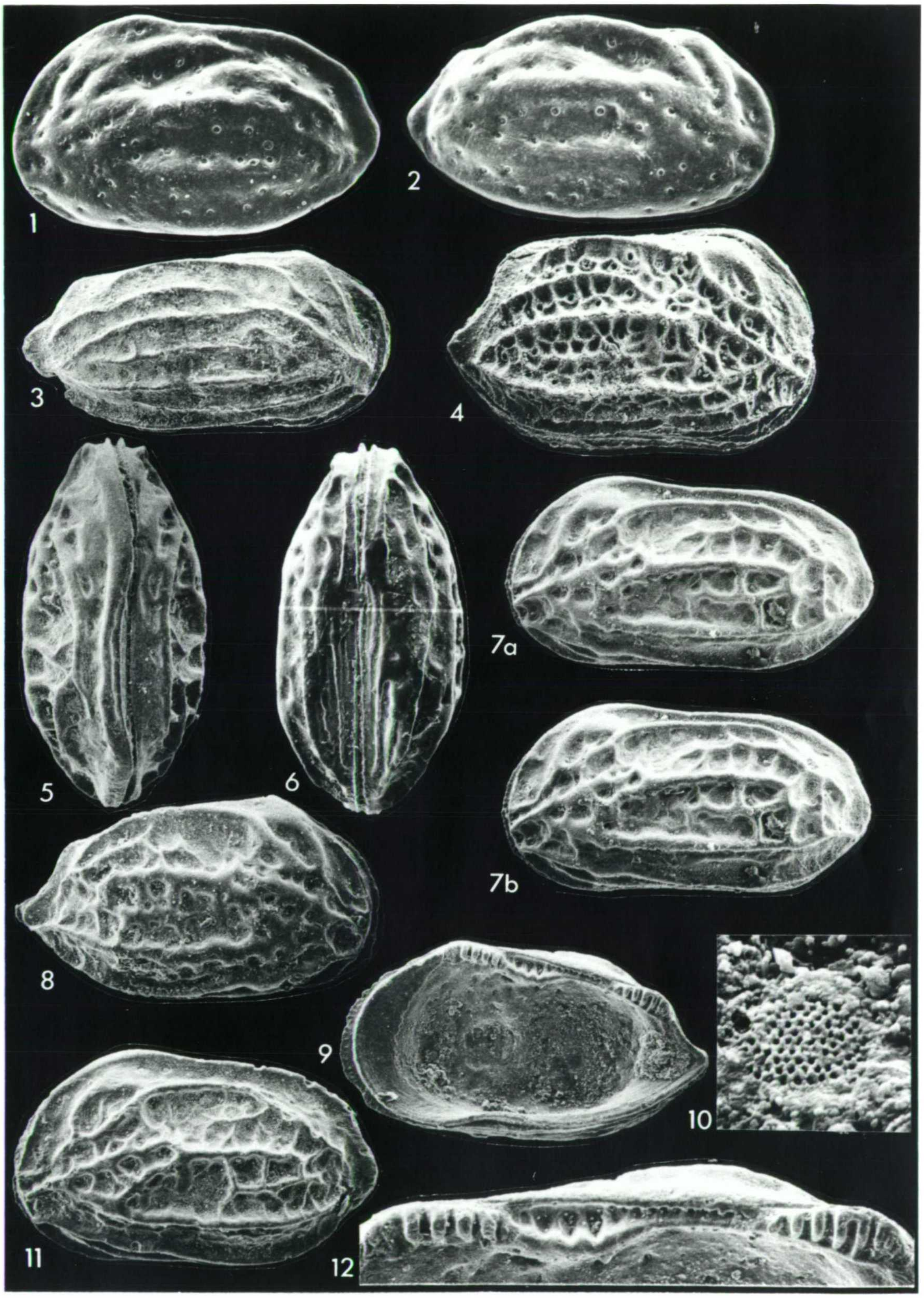
Figs. 1, 2. Terquemula chonvillensis (Dépêche): fig. 1, ♂ LV., MPA 6033-C1 (.68 mm long, x 88), U. Bathonian, Fuller's Earth Rock equivalent, depth 230.00 m, Seabarn Farm borehole; fig. 2, ♂ RV, MPA 6033-C2 (.68 mm long, x 88) U. Bathonian, as above.

Fig. 3. Terquemula septicostata (Bate), ♂ RV, JM 1478-C1 (.76 mm long, x 78), U. Bathonian, Forest Marble, Calvert borehole.

Fig. 4. Terquemula bradiana (Jones), ♀ car., R side, OS 11497 (.67 mm long, x 89), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.2.79).

Figs. 5 - 12. Terquemula robusta sp. nov.: figs. 5, 6, 7, 10, holotype, ♂ car., SAC 2363-C1 (.60 mm long): fig. 5, dors. (x 100); fig. 6, vent. (x 100); fig. 7, stereo-pair of L side (x 100); fig. 10, normal pore canal opening with sieve plate (x 2K), U. Bathonian, Frome Clay, depth 41.17 - 41.70 m, Frome borehole; fig. 8, ♀ RV, SAC 2366-C1 (.57 mm long, x 105), U. Bathonian, as above, depth 42.66 - 42.77 m; figs. 9, 12, ♀ RV, SAC 2366-C2 (.57 mm long): fig. 9, int. lat. (x 105); fig. 12, hinge (x 210), U. Bathonian, as above; fig. 11, ♀ LV, SAC 2363-C2 (.56 mm long, x 107), U. Bathonian, as above, depth 41.17 - 41.70 m.

PLATE 11



dividing into two parallel ridges and a short rib posteriorly situated between the dorsal and median ridges. Dépêche's material similarly showed such variation (personal examination of her material in Paris, February 1980) although she figured only the simple 3-ridge morphotypes. Consequently, this species would be better accommodated within the genus Terquemula. Dépêche states that the species ranges into the Callovian but on examination of the Callovian specimens they are not here regarded as being conspecific.

T. chonvillensis is a very common faunal element within the polonica Zone of the Dorset Province. It was originally used as index ostracod of Bate's Zone 4 (see Sheppard, 1981) but its vertical range has now been extended so that it first appears within the underlying M. Bathonian confossa Zone.

The probable phylogenetic relationship between this species and T. bradiana was obviously realised when it was termed T. bradiana morphotype B by Bate in 1978. T. chonvillensis is here considered to be the basic form from which two closely related species: T. bradiana and T. robusta sp. nov. evolve; the morphological changes which take place are illustrated in Fig. 5-3.

Terquemula bradiana (Jones, 1884)

(Pl. 11, fig. 4; text fig. 5-4)

1884 Cythere bradiana Jones, 772, pl. 34, figs. 38a-b.

1948 Lophocythere bradiana (Jones); Sylvester-Bradley, 196, pl. 14, figs. 7 - 10; pl. 15, figs. 8 - 11.

1975 Lophocythere (Neurocythere) bradiana (Jones); Mayes, 165, pl. 2, 166; pl. 2, 168; pl. 2, 170; pl. 2, 172.

1978 Terquemula bradiana (Jones); Bate, 238, pl. 7, figs. 6, 9.

DIAGNOSIS. Carapace with four major carinae converging towards antero-ventral region; a short rib occurs between ventral and lowest median carinae in anterior half of valve. A further short rib occurs between dorsal and uppermost median carinae in posterior half of valve; sometimes a similarly

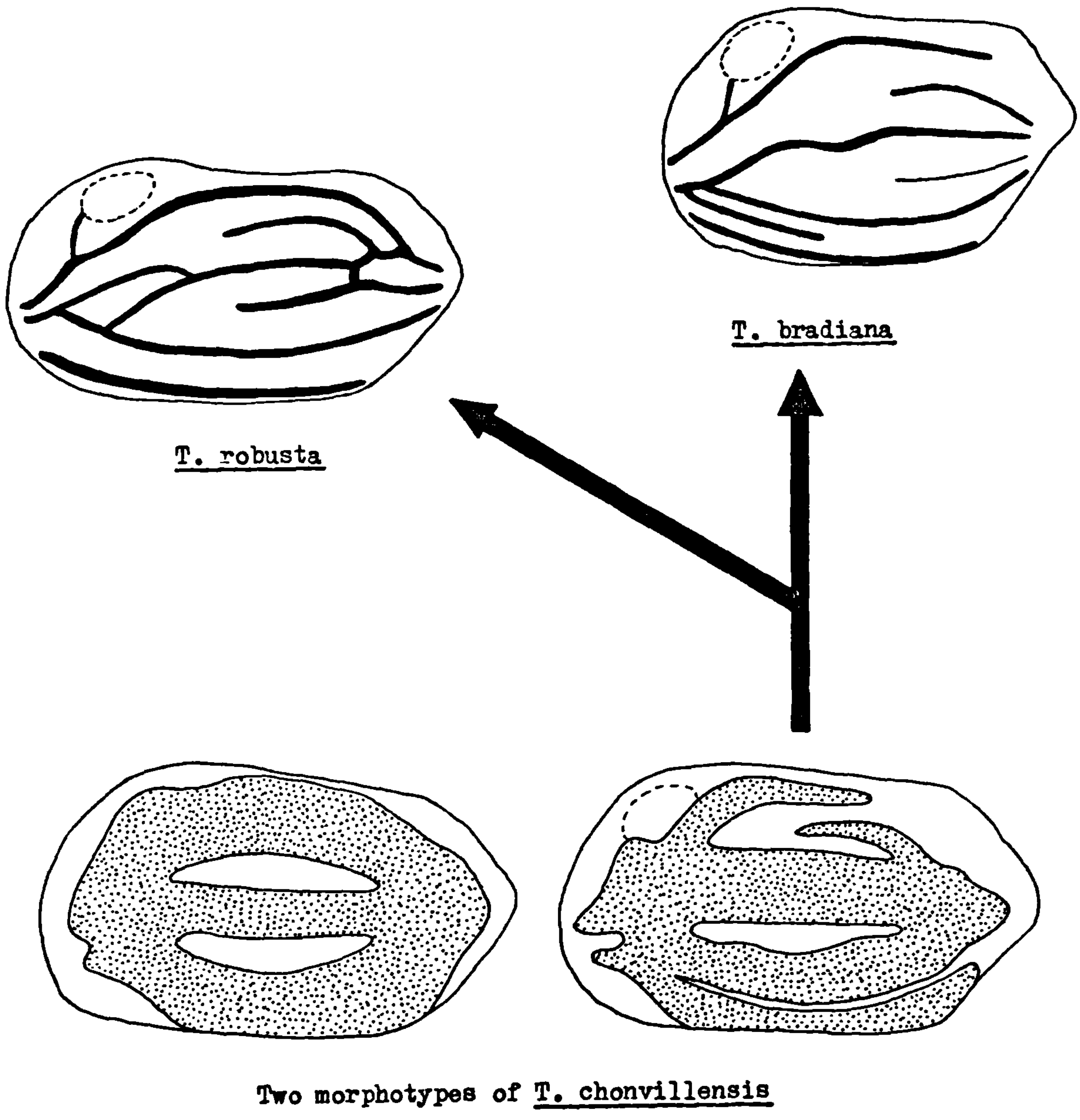


Figure 5-4 Evolution of the 'bradiana' type of ornament.

situated rib occurs between median carinae. Shell surface reticulate between carinae.

MATERIAL. 31 valves and carapaces.

DESCRIPTION. See Bate (1969).

DISTRIBUTION. A commonly occurring ostracod within U. Bathonian U. Fuller's Earth of Surrey (type locality being the Richmond boring), boueti Bed of Langton Herring Dorset (Sylvester-Bradley), blakeana and falcata Zones of Wiltshire and Somerset (Bate, 1978, 1979), and from Bathonian and Callovian sediments of Lorraine (Dépêche, 1969). It is further recorded here from polonica to falcata Zones in several of the Dorset Province boreholes and from the falcata Zone of the Kent-Boulonnais Province. It is known rarely from the U. Bathonian of Normandy.

ECOLOGY. Shallow-water marine. Clay/limestone facies, prefers high energy environment.

REMARKS. The probable evolution from T. chonvillensis has already been mentioned under 'Remarks' for that species (see also fig. 5-4).

Terquemula robusta sp. nov.

(Pl. 11, figs. 5 - 12; pl. 12, figs. 1, 2)

DERIVATION OF NAME. Latin, strong, referring to well developed surface ribbing.

DIAGNOSIS. Terquemula with four major carinae converging anteroventrally and posteroventrally. Two shorter ribs lie between dorsal and upper median carinae and between both median carinae, in posterior half of shell. Anteriorly and posteriorly the carinae fuse to form a loose reticulation.

MATERIAL. 55 valves and carapaces.

HOLOTYPE. Male carapace, SAC 2363-C1, Frome clay, U. Bathonian (blakeana Zone), Frome borehole, depth 41.17 - 41.70 m, Dorset Province.

DESCRIPTION. Subquadrate carapace strongly ornamented by surface carinae. The first (dorsal) carina commences mid-anteriorly and extends up and around smooth eye node, to which a short branch runs, then parallels dorsal margin to die out mid-dorsally, just in front of smooth marginal zone.

Explanation of Plate 12

Figs. 1, 2. Terquemula robusta sp. nov.: fig. 1, ♂ car., R side, SAC 2365-C1 (.66 mm long, x 90), U. Bathonian, Frome Clay, depth 42.22 - 41.66 m, Frome borehole; fig. 2, holotype, ♂ car., R side (.60 mm long, x 100), U. Bathonian, as above, depth 41.17 - 41.70 m.

Fig. 3. ? Terquemula acutiplicata (Jones & Sherborn), ♀ LV, SAC 2361-C1 (.55 mm long, x 109), U. Bathonian, Forest Marble, depth 39.71 - 40.62 m, Frome borehole.

Figs. 4 - 7. Fossaterquemula blakeana (Jones): fig. 4, ♀ RV, OS 11596 (.59 mm long, x 101), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.2.79); fig. 5, ♂ car., dors., MPK 2826 (.68 mm long, x 88), U. Bathonian, Forest Marble, depth 93.00 m, Seabarn Farm borehole; figs. 6, 7, ♂ LV, MPK 2827 (.68 mm long): fig. 6, ext. lat. (x 88); fig. 7, normal pore canal opening with sieve plate (x 830), U. Bathonian as above.

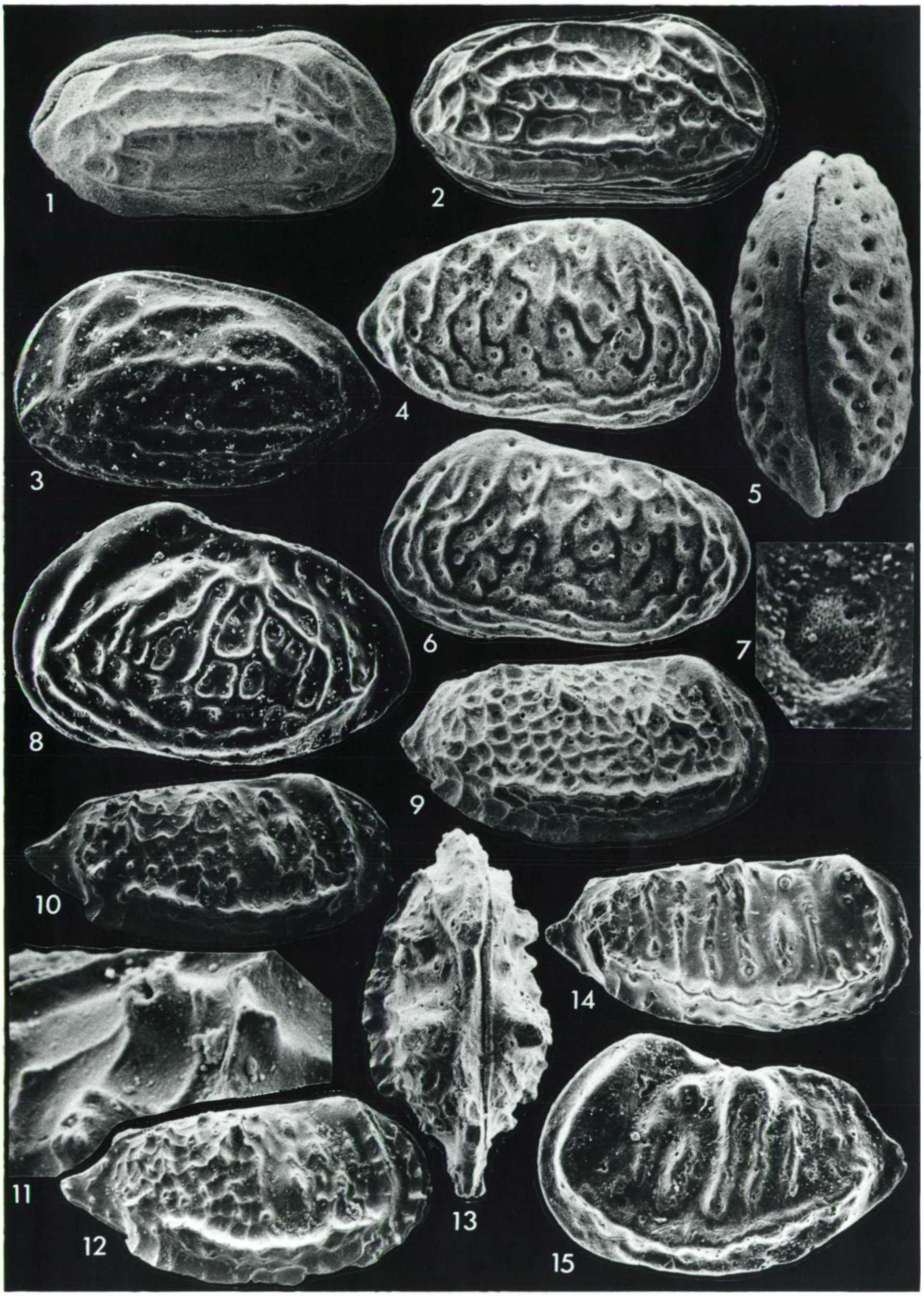
Fig. 8. Fastigatocythere juglandica (Jones), LV, OS 11606 (.83 mm long, x 72), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.1.79).

Fig. 9. Lophocythere ostreata (Jones & Sherborn), ♂ RV, OS 11492 (.86 mm long, x 69), U. Bathonian, as above.

Figs. 10 - 12. Lophocythere batei Malz: fig. 10, ♂ RV, SAZ 1027-C1 (.74 mm long, x 81), U. Bathonian, Forest Marble, depth 20.00 m, Lyme Bay borehole 74/35; figs. 11, 12, ♀ RV, SAZ 1017-C1 (.68 mm long): fig. 11, detail of ornament (x 450); fig. 12, ext. lat. (x 88), U. Bathonian, as above, depth 10.00 m.

Figs. 13-15 Lophocythere propinqua Malz: fig. 13, ♀ car., dors., OS 11605 (.61 mm long, x 98), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.2.79); fig. 14, ♂ RV, OS 11604 (.68 mm long, x 88), U. Bathonian, as above; fig. 15, ♀ LV, OS 11603 (.76 mm long, x 78), U. Bathonian, as above.

PLATE 12



The second carina commences below first and bifurcates, top branch extending along median area of shell and finishing a short distance in front of dorsal margin, bottom branch bending down slightly to parallel ventral margin and finishes at posterior margin. Fourth carina runs beneath this, parallelling ventral margin. Two shorter carinae are situated dorsally between first and second, and second and third carinae. Further short cross-members occur between the primary carinae forming a reticulation which is more pronounced anteriorly and posteriorly.

LV much larger than RV which it overlaps strongly along dorsal margin. Greatest height of carapace at anterior cardinal angle, greatest length and width medially. Sexual dimorphism pronounced, males being considerably longer than females.

Hinge strongly entomodont. All other internal features as for genus.

DIMENSIONS.

		L	H	W	Depth (m)
holotype, ♂ car.,	SAC 2363-C1	.60	.30	.28	41.17 - 41.70
paratypes: ♀ LV,	SAC 2363-C2	.56	.33		"
♂ car.,	SAC 2365-C1	.66	.33	.32	42.22 - 42.66
♀ RV,	SAC 2366-C1	.57	.31		42.66 - 42.77
♀ RV,	SAC 2366-C2	.57	.30		"
♀ car.,	SAC 2366-C3	.59	.34	.26	"
♂ RV,	SAC 2362-C1	.62	.30		40.62 - 41.17

DISTRIBUTION. Known only from the type locality, depths 39.71 - 42.77 m, Frome clay, U. Bathonian (blakeana Zone).

ECOLOGY. Shallow water marine.

REMARKS. The basic 4-rib pattern of T. bradiana is seen here but with certain modifications which are considered sufficient to merit separate specific status. The short anterior rib present between the third and fourth carinae in T. bradiana is absent; the two short posterior ribs of T. bradiana are much more strongly developed here and are always present (in T. bradiana the lower of the two is variously developed and in some forms absent); the intercostate reticulation of T. bradiana is rather differently developed here - it is a much more open reticulation but the individual murae are much thicker and stronger. There is a tendency, too for the reticulate network to be restricted to the anterior and posterior regions. T. robusta is, however, very close morphologically to T. bradiana and is considered to be derived from T. bradiana stock (see fig. 5-3).

The U. Oxfordian species T. multicostata (Oertli, 1957) from a boring in the western Paris Basin, again has the same basic ribbing arrangement but has a closer network of reticulation and towards the posterior margin the central carina, and the two either side of it, fuse completely: they do not in T. robusta.

Terquemula septicostata (Bate, 1967)

(Pl. 11, fig. 3)

1888 Cytheridea bradiana Jones & Sherborn, 272, pl. 4, figs. 11a - c.

1967 Lophocythere septicostata Bate, 52, pl. 15, figs. 7 - 13; pl. 16, figs. 1 - 4.

1979 Terquemula septicostata (Bate); Bate, fig. 2.

DIAGNOSIS. Carapace with seven longitudinal ridges on lateral surface and two on ventral surface. A vertical ridge extends down from oval eye swelling.

MATERIAL. 3 valves.

DESCRIPTION. See Bate (1967).

DISTRIBUTION. Known from the Blue Fuller's Earth Clay of Bath (Jones & Sherborn, 1888), the U. Bathonian U. Estuarine Series of Northamptonshire (Bate, 1967) and the U. Fuller's Earth (blakeana Zone) of Bath (Bate, 1979). Recorded here from the Forest Marble of the Calvert borehole, Kent-Boulonnais Province only.

ECOLOGY. Shallow water marine, littoral to sublittoral environments.

REMARKS. This species appears restricted to the shallow marginal marine facies bordering the Bathonian landmasses of central and south-eastern England. It has not, however, been recorded outside England although morphologically it is similar to the U. Bathonian Polish type-species T. parallela Blaszyk, 1965. The ribs in T. parallela are much thicker and more rounded.

Dépêche, in 1973, placed this species in synonymy with T. bradiana (p.216) which is here regarded as incorrect owing to the lack of reticulation in T. septicostata.

?Terquemula acutiplicata (Jones & Sherborn, 1888)
(Pl. 12, fig. 3)

1888 Cytheridea acutiplicata Jones & Sherborn, 271, pl. 4, figs. 7a - b, 8a - c.
1969 Lophocythere acutiplicata (Jones & Sherborn); Bate, 416, pl. 1, fig. 8; pl. 12, figs. 4, 6.
1978 Terquemula acutiplicata (Jones & Sherborn); Bate, 238, pl. 7, figs. 7, 8.

DIAGNOSIS. Carapace strongly tapering posteriorly with three ventrolateral ridges, weak irregular median ridge; short anteromedian and posterodorsal ridges. Shell surface smooth. Hinge antimerodont to entomodont.
MATERIAL. 17 valves and carapaces.
DESCRIPTION. See Bate (1969) for full description.
DISTRIBUTION. Known from the U. Bathonian Blue and Yellow Fuller's Earth Clay (polonica and blakeana Zones) Bath, Somerset. It is recorded here only from the Frome Clay, Frome borehole, Dorset Province.
ECOLOGY. Shallow-water marine.
REMARKS. There are two reasons for querying the generic assignment; firstly, the strongly tapered shape of the carapace is in disagreement with the more subquadrate nature of true Terquemula carapaces; secondly, the variable nature of the hinge is atypical. Although the single specimen of this species recorded here has an entomodont structure the type material, figured by Bate in 1969 has an antimerodont type. A more thorough re-examination of the species is required than was possible here. From the available information, however, it would appear that ?T. acutiplicata is derived from T. septicostata stock, having a similar, if reduced arrangement of ribs with no surface reticulation, and not from T. bradiana as has been previously suggested (Bate, 1978, p.238).

Genus Fossaterquemula Gründel, 1975.

REMARKS. Originally erected by Gründel as a subgenus of Terquemula Blaszyk & Malz, Fossaterquemula was distinguished by having a surface ornamentation primarily of large pit-like normal pore canal openings. It further differs from Terquemula in shape, having a larger length to height ratio, being constricted mid-dorsally and mid-ventrally and in the postero-lateral part of the carapace being swollen. These differences are here considered sufficient to merit Fossaterquemula with generic status. It is at present monospecific.

TYPE SPECIES. F. blakeana (Jones, 1884).

Fossaterquemula blakeana (Jones, 1884)

(Pl. 12, figs. 4-7)

1884 Cythere blakeana Jones, 772, pl. 34, figs. 34, 35.

1948 Progonocythere blakeana (Jones); Sylvester-Bradley, 191, pl. 12, figs. 3, 4; pl. 13, figs. 4, 5.

1963 Progonocythere ? blakeana (Jones); Oertli, 36, pl. 28, fig. c; pl. 30, fig. c (not pl. 25, fig. c; pl. 26, fig. c; pl. 27, fig. c).

1969 Terquemula blakeana (Jones); Bate, 393, pl. 4, fig. 8; pl. 5, fig. 1.

1975 Terquemula (Fossaterquemula) blakeana (Jones); Gründel, 367, fig. 6.

DIAGNOSIS. Carapace subquadrate, constricted mid-dorsally and mid-ventrally. Posterolateral part of carapace swollen, overreaching ventral margin. Shell surface with large, sunken normal pore canal openings and broad reticulation of wrinkles.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Bate (1969).

DISTRIBUTION. Previously recorded from U. Bathonian sediments within southern England (Jones, 1888, Sylvester-Bradley, 1948, Bate, 1979) and the Meurth-et-Moselle region of France (Oertli, 1963). It is here recorded from the U. Bathonian of all three provinces.

ECOLOGY. Shallow water marine.

REMARKS. Morphologically this species is very close to Strictocythere polonica (Blaszyk, 1959) and in the literature the two have been confused (e.g. Oertli, 1963, figures S. polonica as F. blakeana on pl. 25, fig. c; pl. 26, fig. c and pl. 27, fig. c from L. to M. Bathonian sediments in France). F. blakeana is distinguished by the pronounced mid-ventral constriction of the valves, the posterolateral swelling of the carapace and the more pronounced posterior cardinal angle. In addition F. blakeana is characterised by an often well-developed surface reticulation of wrinkles that is absent in S. polonica.

F. blakeana is currently used as index ostracod for the U. Bathonian blakeana Zone, recognised in all three sampling provinces, lying above the polonica Zone. The close morphology of the two species implies a phylogenetic relationship with S. polonica giving rise to F. blakeana. Obviously if two such closely related species from different genera are to be used as critical stratigraphical indicators then one must be sure of the two following points: (a) the evolution from one species to another is not a spontaneous process but involves transition stages; can the true F. blakeana be recognised with certainty from S. polonica, i.e. can the precise zonal boundary be fixed within a sequence of sediments containing both species? (b) As the two species are so close morphologically should they not belong to the same genus, i.e. is Strictocythere a valid genus?

It is rare to witness evolution taking place within sediments. More often than not, two end-members of an evolutionary lineage are seen in beds of different ages, but the actual change in form occurs elsewhere. Within the Dorset Province, however, the complete evolutionary process in question can be observed within several of the subsurface sequences. Fig. 5-5 demonstrates the changes in carapace form which occur. The transition stage, which could be termed the 'proto-blakeana' form, still has the elongate-oval outline and the triangular caudal process. The ventral margin, however, has already become slightly incurved medially, the posterolateral part of the carapace is beginning to swell and there are the beginnings of vertical surface wrinkles forming, which make it quite distinct from S. polonica. The true F. blakeana is recognised by the reduced caudal process, the pronounced swelling of the posterolateral part of the carapace

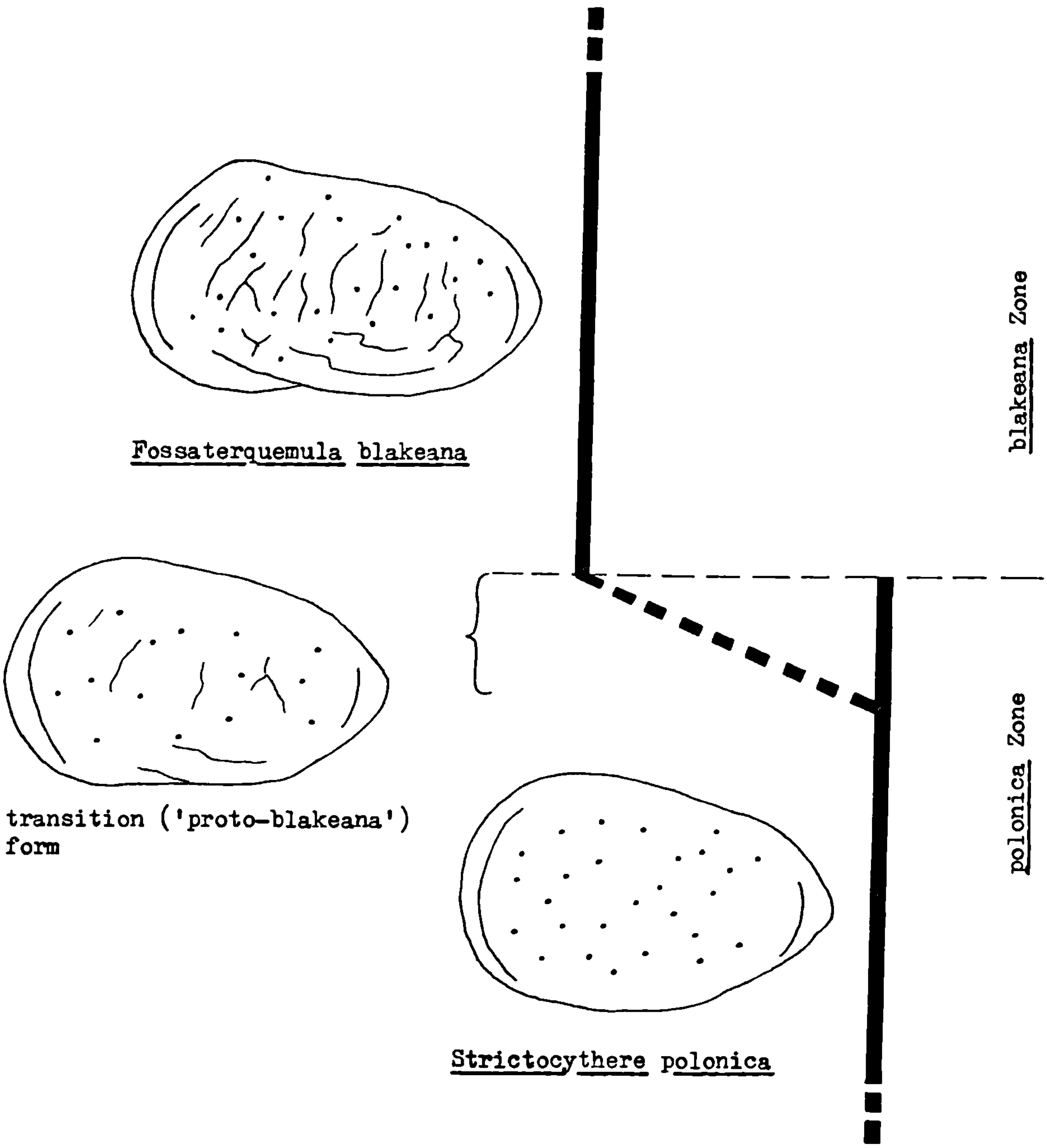


FIGURE 5-5 Evolution of Fossaterquemula from Strictocythere in the Upper Bathonian.

which accentuates the mid-ventral incurvature, and the well-developed system of ridge-like wrinkles, vertical laterally and horizontal ventrally. This entire change in form may be seen to take place over as little as 1 metre of sediment which, in terms of time, represents something like 1000 years. The zonal boundary may be consequently drawn anywhere within this range, which for the purpose of a wide-scale zonation scheme, is quite accurate enough. It should be noted here that the evolution of F. blakeana is not prompted or accompanied by any distinct facies change; such a change would, of course, significantly reduce the stratigraphic importance of the event.

Regarding point (b) it must be stated that shape is considered the one most important criterioı in differentiating between Strictocythere and Fossaterquemula.

Genus Fastigatocythere Wienholz, 1967

Fastigatocythere juglandica (Jones, 1884)

(Pl. 12, fig. 8)

1884 Cythere juglandica Jones, 766, 768, pl. 34, figs. 36, 37.

1948 Progonocythere juglandica (Jones); Sylvester-Bradley, 193, pl. 12, figs. 5, 6; pl. 13, fig. 8.

1967 Glyptocythere juglandica (Jones); Bate, 51.

1969 Fastigatocythere juglandica (Jones); Bate, 389, pl. 3, figs. 4, 7, 8; pl. 12, fig. 3.

DIAGNOSIS. Subrectangular carapace, tapering strongly to posterior. Ornamentation of transverse ridges diverging away from dorsal margin; coarse intercostate reticulation; prominent dorsomedian projection in right valve.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Sylvester-Bradley, 1948.

DISTRIBUTION. A widespread Bathonian species recorded from eastern and southern England (Bate, 1967, 1969, 1978), France (Oertli, 1963) and the Ukraine (Permyakova, 1978). It is recorded herein from U. Bathonian (polonica to falcata Zones) of the Dorset and Kent-Boulonnais Provinces where it is a common faunal element.

ECOLOGY. Marine, preferring shallow water high-energy environments near to land.

REMARKS. This is the oldest known species of Fastigatocythere which is a Bathonian/Callovian genus common in European sediments. The generic assignment of F. juglandica has been a little uncertain as shown by the synonymy (for full synonymy see Bate, 1969); the assignment to Fastigatocythere is accepted here. The distinguishing features of the genus are elongated carapace outline, positive anterodorsal furrow and strongly diverging ribs radiating from the dorsal margin.

Genus Lophocythere Sylvester-Bradley, 1948.

DIAGNOSIS. Genus of Progonocytherinae characterised by a strong ventral rib and a strong ventrolateral rib which changes direction through 90^{o} anteroventrally and extends to smooth eye node. Shell surface reticulate, tuberculate or spinose.

TYPE SPECIES. Lophocythere ostreata (Jones & Sherborn).

REMARKS. Subsequent to the original erection of the genus, a great many species were assigned to Lophocythere and subgenera were erected to accommodate their different ornamental patterns. The genus is here restricted to accommodate only those forms possessing the L-shaped ridge as found in the type-species (termed the 'ostreata group' by Bate, 1969). Lophocythere (Neurocythere) Whatley, 1970, possessing lateral ridges that fuse anteriorly, is a junior synonym of Terquemula Blaszyk and Malz, 1965, while Lophocythere (Fastigatocythere) Wienholz, 1967, used by Dépêche in 1973 with subgeneric status is here returned to its original generic status as diagnosed by Wienholz.

Within the study area only four previously described species of Lophocythere have been found and these all occur in S. England and Boulonnais; the genus is absent from the Bathonian of Normandy. Lophocythere is a common Bathonian genus, first appearing in the L. Bathonian, flourishes in the M. and U. Bathonian with a few species remaining in the Callovian and Oxfordian though most die out by the close of the Bathonian. Species of the genus have been recorded from Bathonian sediments of Britain, eastern France, NW Germany and Poland, but it is not until the close of the Callovian (lamberti ammonite Zone) that the first species, L. karpinskyi (Mandelstam), is recorded from Normandy. This fact alone must play an important part in the interpretation of the environmental conditions at the time as Lophocythere is largely a facies-independent genus. The absence of species in Normandy implies a barrier to distribution which was apparently removed by Callovian times. It is not the intention, however, to deal with this problem in isolation here; as this situation is found too in other genera the problem is being dealt with in detail in the ecology chapter.

Another important feature of the genus is the marked disparity in species abundances and distribution. L. ostreata is, by far, the commonest and longest-ranging species. It is here considered ancestral to all other species of the genus where there is a tendency for reduction in the surface reticulation to a smooth shell with exaggeration of the secondary vertical ribbing, for example from L. ostreata, through L. batei to L. propinqua (see pl. 12, figs. 9, 12, 14). L. fulgurata appears to form a separate offshoot with a slightly different surface ornament arrangement than in all the others. Table 5-7 shows a suggested evolutionary scheme for Lophocythere with, included in it, previously described species from NW Europe not occurring in the study area.

Lophocythere ostreata (Jones & Sherborn, 1888)
(Pl. 12, fig. 9)

1888 Cytheridea ostreata Jones & Sherborn, 271, pl. 4, figs. 6a - c.
1888 Cytheridea bicarinata Jones & Sherborn, 270, pl. 4, figs. 5a - c.
1975 Lophocythere (Lophocythere) ostreata (Jones & Sherborn); Mayes, 157 - 164.

DIAGNOSIS. Subquadrate carapace with three major prominences aligned obliquely across each valve; most anterior one situated beneath eye node, most dorsal situated just below and in front of posterior cardinal angle. Shell surface reticulate; ventral keel strongly developed.

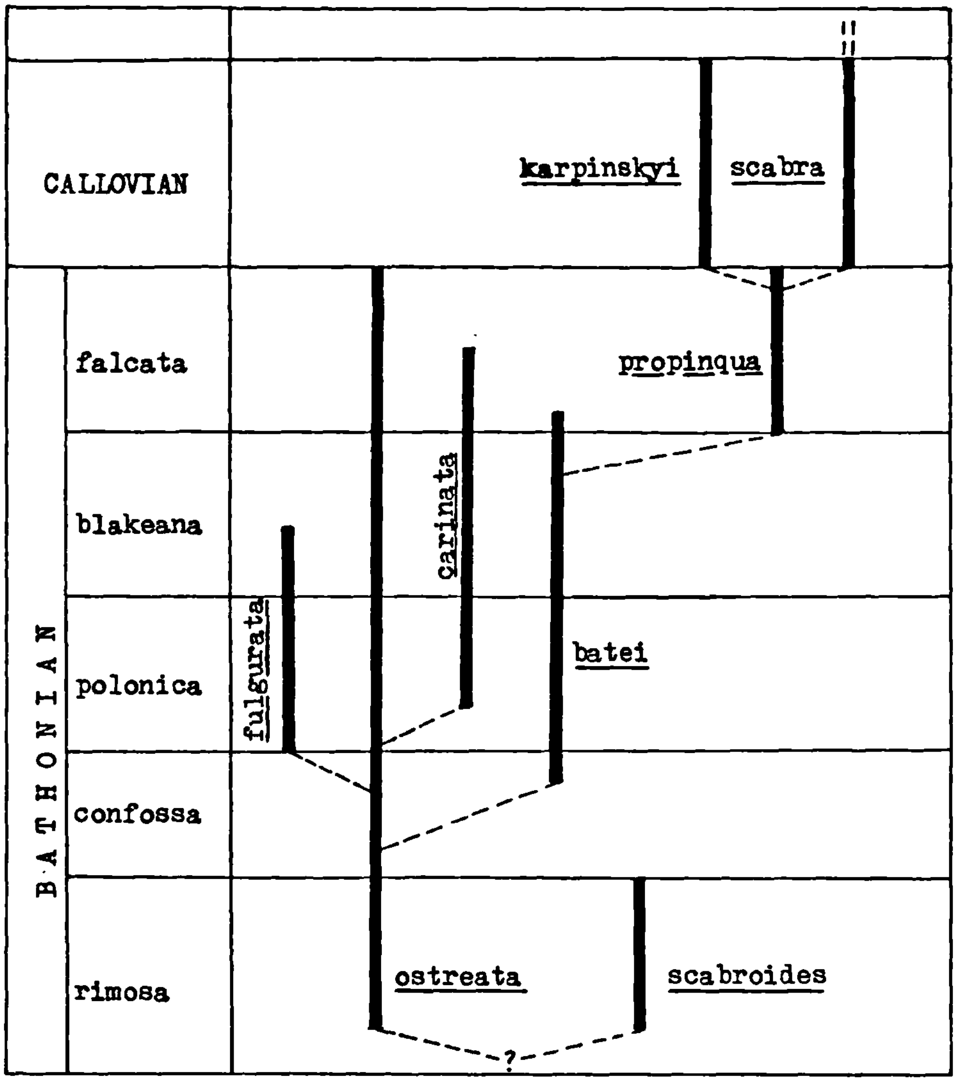


Table 5-7 Evolutionary relationships of species of *Lophocythere*.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. For fully illustrated description see Mayes, 1975.

DISTRIBUTION. A common faunal element in sediments of M. and U. Bathonian age, L. ostreata has been recorded from Oxfordshire, Somerset, Dorset, Wiltshire and Northamptonshire in England, and in Boulonnais and the Vienne Valley, E of Poitiers in France (see Mayes, 1975 for complete locality information). It is known also from the L. Bathonian of Somerset (Bate, 1978). Herein it is recorded from L. to U. Bathonian sediments of the Dorset Province and U. Bathonian (blakeana to falcata ostracod Zones) of the Kent-Boulonnais Province where it is common from both surface and outcrop material.

ECOLOGY. Marine, occurring in both clay and carbonate facies.

REMARKS. This is an extremely common faunal element in the Bathonian of southern England. First appearing in the L. Bathonian it flourishes in the U. Bathonian where it is common in England as well as northern and eastern France, implying a general south-south easterly movement from central and southern England into France but missing Normandy. L. ostreata is considered ancestral to all other species of the genus in NW Europe except for L. scabroides Malz, 1975. This is a L. Bathonian species that existed in eastern France, prior to the arrival of L. ostreata towards the close of the L. Bathonian. The two species were, for the majority of the L. Bathonian, in existence at the same time in different geographic locations. The similarity in their ornamentation suggests that they were derived from the same (unknown) ancestral stock. When L. ostreata moved into France L. scabroides quickly died out; their coexistence there was apparently short, suggesting a competitive influence of L. ostreata which then replaced L. scabroides in the M. and U. Bathonian sediments.

Lophocythere batei Malz, 1975

(Pl. 12, figs. 10-12)

1967 Lophocythere scabra scabra Triebel; Bate, 52, pl. 15, fig. 6.

1975 Lophocythere batei Malz, 127, pl. 1, figs. 6 - 7; pl. 2, figs. 11 - 13; pl. 3, fig. 24; pl. 4, figs. 25 - 26; pl. 5, fig. 37.

DIAGNOSIS. Lophocythere with prominent dorsomedian, bifurcated projection; short vertical ribs and pointed projections variously developed. Weak intercostate reticulation. Normal pore canal openings, with sieve-plates, situated on low conical projections.

MATERIAL. 19 valves.

DISTRIBUTION. Known only from England, from M. to U. Bathonian sediments of Northamptonshire and Oxfordshire. The specimens found in the study area occurred in U. Bathonian Frome Clay (blakeana Zone) from the Lyme Bay borehole.

ECOLOGY. Shallow water marine.

REMARKS. The presence of L. batei in one subsurface section only in the study area and its absence in Europe implies a certain geographic restriction not seen in the other species of the genus described here. A similar southerly movement from the English Midlands, as was seen in L. ostreata, is feasible here though conditions were obviously none too favourable for its development here. Water depth and/or temperature could have been the controlling influence.

L. batei is very similar to L. propinqua and it is likely that L. propinqua developed from L. batei with an accompanying reduction in surface reticulation.

Lophocythere propinqua Malz, 1975.

(Pl. 12, figs. 13 - 15)

1963 Lophocythere scabra Triebel 1951; Oertli, pl. 28, fig. 1w; pl. 29, fig. r; pl. 30, fig. 1w.

1969 Lophocythere scabra Triebel; Dépêche, 116, pl. 3, fig. 10.

1975 Lophocythere propinqua Malz, 129, pl. 4, figs. 28-32; pl. 5, fig. 43.

DIAGNOSIS. Species of Lophocythere with carapace tapering to low pointed posterior. Shell surface smooth with mid-dorsal bifurcate protruberance, bifurcations extending to ventral keel as vertical ribs. Subsidiary vertical ribs present.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Malz, 1975.

DISTRIBUTION. L. propinqua is an U. Bathonian species, the type locality and horizon being Kirtlington, Oxfordshire, Forest Marble. It appears to be restricted to the falcata ostracod Zone, having been further recorded from Oxfordshire (Bate, 1978), Lorraine and Boulonnais of France. Herein it is recorded from the Forest Marble only of the Dorset Province and Forest Marble and lowermost Cornbrash of the Kent-Boulonnais Province.

ECOLOGY. Shallow water marine.

REMARKS. This is a stratigraphically useful species of Lophocythere in that it has not, as yet, been recorded in sediments older than U. Bathonian falcata Zone (discus ammonite Zone), nor in younger sediments. It is commonly associated with L. ostreata (Jones & Sherborn) and Fastigatocythere juglandica (Jones). The probable evolution from L. batei has been mentioned under Remarks for that species; the geographic distribution of L. propinqua would agree with this, with the younger species flourishing in southern England (where L. batei did not) and dispersing further south into Boulonnais and Lorraine. It seems likely, also, that this evolutionary process continued further, giving rise to L. scabra Triebel, 1951 in the Callovian of England and NW Germany, and to L. karpinskyi (Mandelstam, 1955) a particularly widespread species in the Callovian of Normandy and Scotland. The general south easterly movement of the genus as a whole had obviously ceased by the beginning of the Callovian, with the widespread marine transgression at that time bringing about a reversal of its dispersal trend, the remaining species being found over a much wider area.

Lophocythere fulgurata (Jones & Sherborn, 1888)

(Pl. 13, fig. 1)

1888 Cytheridea fulgurata Jones & Sherborn, 273, pl. 4, figs. 12a - c.

1969 Lophocythere fulgurata (Jones & Sherborn); Bate, 419, pl. 12, fig. 7.

1978 Lophocythere fulgurata (Jones & Sherborn); Bate, 236, pl. 6, figs. 14, 15.

DIAGNOSIS. Carapace with two lateral ridges; uppermost one L-shaped, terminating anterodorsally in low eye swelling. Two short, oblique ridges present,

Explanation of Plate 13

Fig. 1. Lophocythere fulgurata (Jones & Sherborn), ♀ LV, BM 5517-C2 (.72 mm long, x 83), U. Bathonian, Forest Marble, St. Margaret's Bay borehole.

Figs. 2-5. Nophrecythere rimosa (Dépêche): fig. 2, ♀ RV, OS 11597 (.49 mm long, x 122), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.6.78); fig. 3, ♀ car., dors., OS 11600 (.62 mm long, x 96), L. Bathonian, as above; figs. 4, 5, ♀ car., MPK 2795 (.55 mm long, x 109): fig. 4, vent., fig. 5, L side, U. Bathonian Fuller's Earth Rock equivalent, depth 213.00 m, Seabarn Farm borehole.

Fig. 6. Nophrecythere bessinensis (Dépêche), ♀ RV, OS 11601 (.55 m long, x 109), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.7.78).

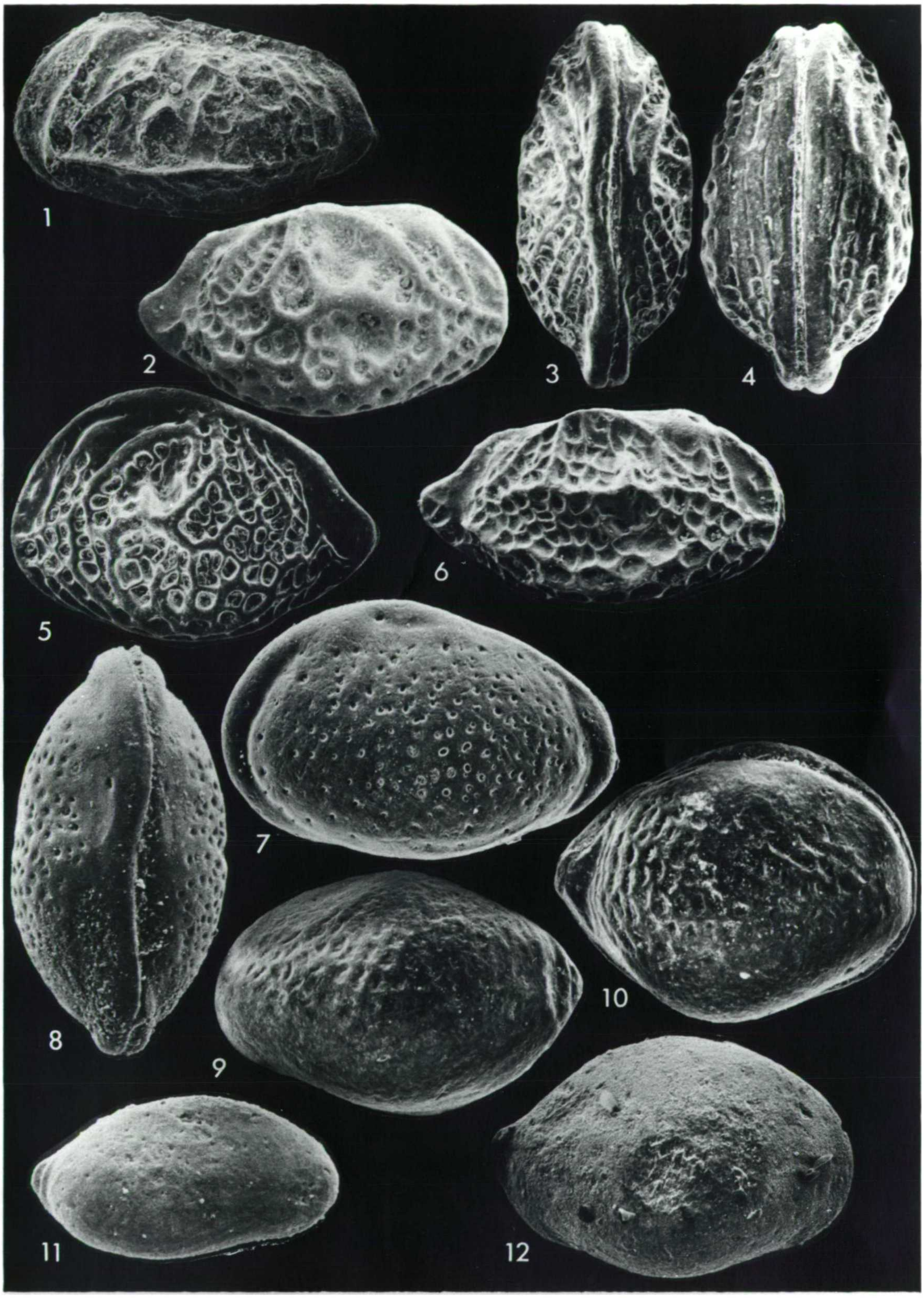
Figs. 7, 8. Merocythere postangusta Sheppard: fig. 7, ♀ LV, MPK 2792 (.55 mm long, x 118), L. Bathonian, L. Fuller's Earth, depth 309.00 m, Seabarn Farm borehole; fig. 8, ♀ car., dors., OS 11507 (.47 mm long, x 138), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.40.78).

Figs. 9, 10. Micropneumatocythere brendae Sheppard: fig. 9, ♀ car., L side, MPA 5479-C1 (.48 mm long, x 125), U. Bathonian, Frome Clay, depth 114.00 m, Seabarn Farm borehole; fig. 10, ♀ car., R side, MPA 5461-C1 (.44 mm long, x 136), U. Bathonian, as above, 105.00 m.

Fig. 11. Micropneumatocythere cracens Bate & Sheppard, ♀ RV, MPA 4718-C1 (.41 mm long, x 119), U. Bathonian, Forest Marble, depth 19.38 - 19.42 m, Seabarn Farm borehole.

Fig. 12. Micropneumatocythere falcata Sheppard, ♀ RV, OS 11794 (.55 mm long, x 109), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.3.79).

PLATE 13



one posterodorsal, the other anteromedian; additional short ridges present. Intercostate areas weakly reticulate.

MATERIAL. 41 valves and carapaces.

DESCRIPTION. See Bate, 1969.

DISTRIBUTION. Recorded from the U. Bathonian U. Fuller's Earth (blakeana Zone) of the Bath area, the Forest Marble (falcata Zone) of Oxfordshire and the Bradford Clay (blakeana Zone of Dorset. In the study area it occurs only within the falcata Zone, Forest Marble of the subsurface material in the Kent-Boulonnais Province. It is unknown from France.

ECOLOGY. Shallow water marine, preferring a carbonate environment, being found usually within a limestone or calcareous clay.

REMARKS. In its pattern of ornamentation, L. fulgurata is quite distinct from all other species of the genus and, although considered to be derived from L. ostreata, does not appear to be closely related to any other species (see Table 5-7). It commonly occurs in association with both L. ostreata and L. propinqua in the U. Bathonian of SE England to which it is geographically restricted.

Genus Nophrecythere Gründel, 1975

REMARKS. Nophrecythere was originally erected as a subgenus of Neurocythere by Gründel but has been used with generic standing by several authors since Neurocythere was discovered to be a junior synonym of Terquemula Blaszyk & Malz, 1965. It is most widespread in the U. Jurassic of NW Europe; the two previously described species recorded here therefore constitute the earliest representatives of the genus. Indeed, the generic range is here extended to include the topmost Bajocian sediments.

Nophrecythere rimosa (Dépêche, 1973)

(Pl. 13, figs. 2-5)

1973 Lophocythere (Fastigatocythere) rimosa Dépêche, 218, pl. 1, figs. 9 - 13.

1978 Nophrecythere rimosa (Dépêche); Bate, 236, pl. 6, figs. 11 - 13, 16.

DIAGNOSIS. Carapace with three prominent costae; dorsal and ventral costae arched, meeting anteriorly with short rib extending to anterior margin; median costa irregular with expanded diamond-shaped development just behind valve centre, apex of diamond joined to dorsal costa by short rib. Intercostate regions coarsely reticulate. Smooth eye swelling.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Dépêche, 1973.

DISTRIBUTION. A long-ranging species, recorded from the L. Bathonian of Normandy and L. to U. Bathonian of the Bath area of southern England. It is further recorded here from the topmost Bajocian to U. Bathonian sediments within several borehole sections of the Dorset Province.

ECOLOGY. Marine, shallow water, preferring, though not restricted to, relatively low energy environments and in a wide variety of lithofacies.

REMARKS. Despite its relatively long range, this is an important species stratigraphically as its first appearance, within the topmost Bajocian, marks the base of the rimosa Subzone of the rimosa Zone. It is a common faunal element, particularly within the more marly facies of Dorset and Normandy but has not been found within the marginal calcareous facies of the Kent-Boulonnais Province.

Nophrecythere bessinensis (Dépêche, 1973)

(Pl. 13, fig. 6)

1973 Lophocythere (Fastigatocythere) bessinensis Dépêche, 217, pl. 1, figs. 3 - 8.

1978 Nophrecythere bessinensis (Dépêche); Bate, 236, pl. 6, figs. 8 - 10.

DIAGNOSIS. Carapace with three prominent costae; dorsal and ventral costae arched, median costa oblique, extending to anterior margin. Intercostate regions coarsely reticulate. Smooth eye swelling.

MATERIAL. 35 valves and carapaces.

DESCRIPTION. See Dépêche, 1973.

DISTRIBUTION. Known from the L. Bathonian of Normandy and L. to M. Bathonian of the Bath area, southern England. It is recorded herein from the L. Bathonian of the Dorset and Normandy Province.
ECOLOGY. Marine, preferring a low-energy clay/marl facies.
REMARKS. This species is very similar to N. rimosa (Dépêche) which is a much longer ranging species and, in terms of numbers of individuals, is far more abundant. N. rimosa is most probably ancestral to N. bessinensis with the latter forming a closely-related offshoot at the base of the Bathonian. The paucity of individuals of N. bessinensis in samples containing both this and N. rimosa would point to competition being the determining factor. This could also lead to the ultimate extinction of N. bessinensis in the M. Bathonian.

Genus Merocythere Oertli, 1957.

Merocythere postangusta Sheppard, 1981

(Pl. 13, figs. 7, 8)

1978 Merocythere sp. Bate, 221, pl. 11, figs. 9 - 12.
1981 Merocythere postangusta Sheppard (in press).

DIAGNOSIS. Small Merocythere with narrow posterior end and surface ornamentation of small subcircular pits.
MATERIAL. 67 valves and carapaces.
DESCRIPTION. See Sheppard, 1981.
DISTRIBUTION. A common L. Bathonian ostracod, recorded previously from the L. Fuller's Earth of southern England and Marnes de Port-en-Bessin of Normandy, where it is currently used as index ostracod for the postangusta Subzone of the rimosa Zone. It occurs in the Dorset and Normandy Provinces.
ECOLOGY. Shallow water marine, inhabiting a sublittoral environment.
REMARKS. The constant first appearance of this species in the L. Fuller's Earth and equivalent beds has enabled it to be of significant stratigraphic use in building up the Bathonian ostracod zonation scheme (see Sheppard, 1981).

M. postangusta represents the earliest species of the genus to date, Merocythere being a typically U. Jurassic genus. It differs from M. plena

(Schmidt) in Oertli (1957, 676, pl. 7, figs. 227, 228) and M. plena pauciperforata (Donze) in Donze (1960, 24, pl. 6, figs. 70 - 73) by being smaller, having distinct compressed marginal areas anteriorly and posteriorly and having a low positioned posterior margin.

Genus Micropneumatocythere Bate, 1963

REMARKS. Within the study area six species of Micropneumatocythere are present, one of which, M. triangula, is new. Micropneumatocythere is a very common Bathonian genus, particularly within the U. Bathonian, the individuals of certain species, in particular M. brendae and M. falcata, often representing the major faunal component in any one sample. It is a stratigraphically useful genus in that two species at least, M. brendae and M. falcata are zonally important with M. falcata being used as index ostracod for the highest Bathonian ostracod Zone. The genus as a whole is not restricted to any one environment or facies-type; individuals are found in sediments laid down under purely marine to brackish waters.

Micropneumatocythere brendae Sheppard, 1978
(Pl. 13, figs. 9, 10)

1978 Micropneumatocythere sp. A Bate, 234, pl. 5, figs. 8 - 10, 15, 16.
1978 Micropneumatocythere brendae Sheppard, 89-96.
1979 Micropneumatocythere brendae Sheppard; Bate & Sheppard, 80, pl. 1, figs. 3 - 7.

DIAGNOSIS. Species of Micropneumatocythere with or without surface reticulation of three- or four-sided pits. Dorsal margin highly arched with steep posterodorsal slope. Carapace strongly convex with well developed caudal process in male and female dimorphs.
MATERIAL. Over 100 valves and carapaces.
DESCRIPTION. See Sheppard, 1978.
DISTRIBUTION. Previously recorded from several Geological Survey boreholes

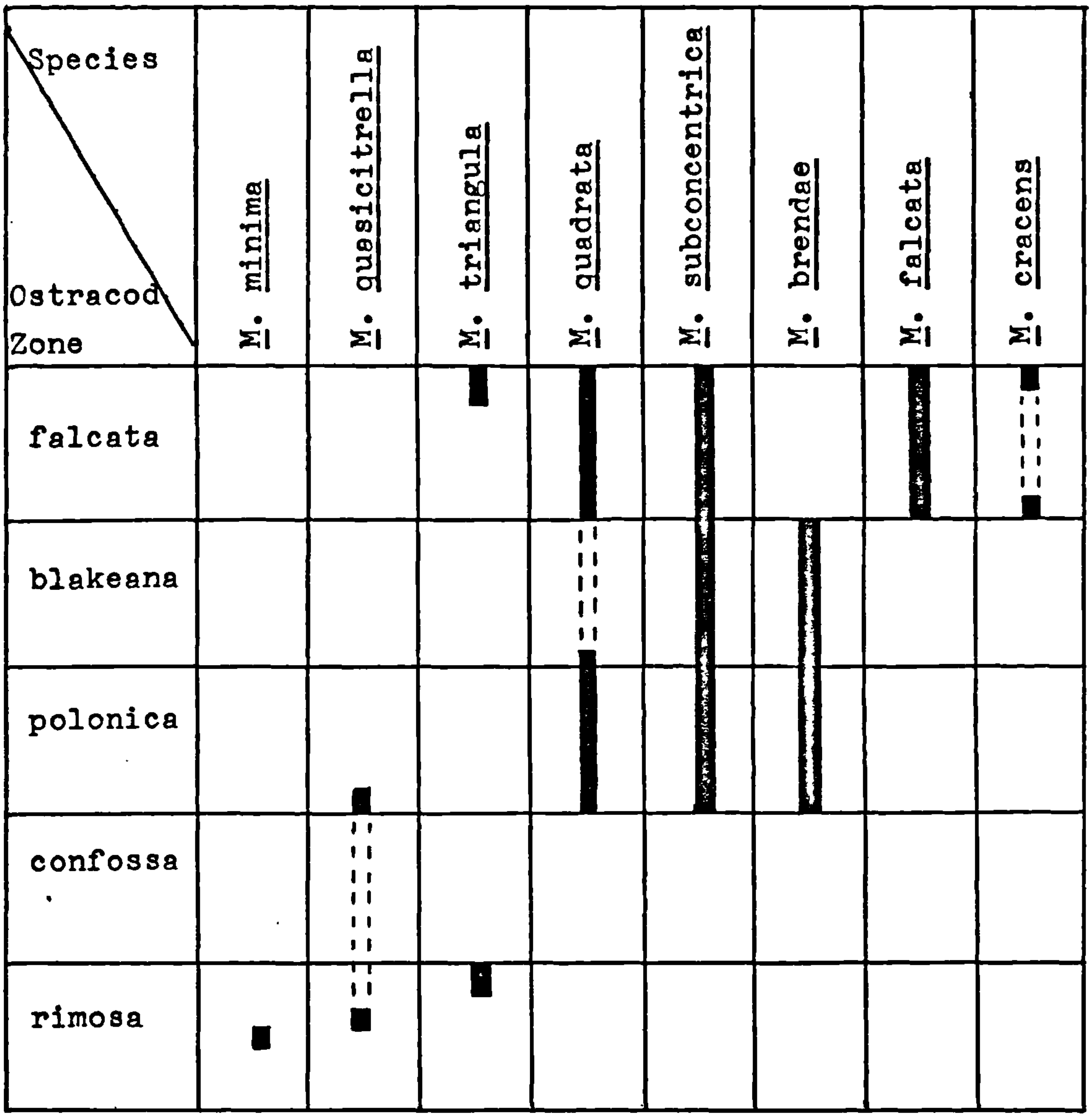


Table 5-8 The stratigraphical distribution of species of *Micropneumatocythere* in the Bathonian.

in southern England from the U. Fuller's Earth (polonica to blakeana Zones) and also from the U. Estuarine Series of Norwich, Norfolk. It is further recorded here from the Frome Clay in addition to the U. Fuller's Earth within several borehole sections of the Dorset Province; from the Great Oolite of the Kent-Boulonnais Province boreholes and, very rarely, from the Campagnettes Member (blakeana Zone at Ranville in the Normandy Province.

ECOLOGY. Marine, shallow water, inhabiting a high energy, inner-shelf, near-shore environment, typical of the U. Fuller's Earth period.

REMARKS. M. brendae is found only within the U. Bathonian polonica and blakeana Zones and as such is a good stratigraphic indicator. It is unique in that it is the only species of the genus exhibiting two types of shell surface: pitted and smooth (see Sheppard, 1978). The smooth form is found only towards the top of its stratigraphical range, where it forms a transition stage between M. brendae and the completely smooth species, M. falcata.

Micropneumatocythere cracens Bate & Sheppard, 1979

(Pl. 13, fig. 11)

1979 Micropneumatocythere cracens Bate & Sheppard, 81, pl. 1, figs. 10, 11, 13, 16, text-figs. 1, 2.

DIAGNOSIS. Small species of Micropneumatocythere with slender carapace, rather more elongate than normal for the genus. Dorsal margin broadly rounded with gently inclined posterodorsal slope. Carapace posteriorly swollen in male dimorph.

MATERIAL. 3 valves.

DESCRIPTION. See Bate & Sheppard, 1979.

DISTRIBUTION. Previously recorded from the White Limestone, U. Bathonian (falcata Zone) of Oxfordshire (Bate & Sheppard, 1979; Ware & Whatley, 1980). Here in it is known only from the topmost Forest Marble, at the junction of the L. Cornbrash within the Seabarn Farm borehole, Dorset Province.

ECOLOGY. Shallow water marine, near shore environment.

REMARKS. This is a very rare member of the U. Bathonian fauna of southern

England and has, so far, only been found in association with M. falcata.

Micropneumatocythere falcata Sheppard, 1978
(Pl. 13, fig. 12; pl. 14, fig. 1)

1978 Micropneumatocythere sp. E. Bate, 234 (not pl. 5, figs. 11 - 14)

1978 Micropneumatocythere falcata Sheppard, 97 - 100.

1979 Micropneumatocythere falcata Sheppard; Bate & Sheppard, 82, pl. 1, figs. 12, 14, 15, 17.

DIAGNOSIS. Micropneumatocythere with sickle-shaped dorsal outline in female dimorph. Anterior margin broadly rounded, posterior triangular. Shell surface smooth with large, widely-spaced pore canal openings. Several parallel ridges running along ventral and ventrolateral surfaces.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Sheppard, 1978.

DISTRIBUTION. Known from the top of the White Limestone and entire Forest Marble of Oxfordshire, the topmost Great Oolite and Forest Marble of Kent and the Forest Marble of Dorset. It is restricted to, and is used as the index ostracod for, the topmost Bathonian Zone, the falcata Zone. It is further recorded herein from several borehole sections of the Dorset and Kent-Boulonnais Provinces as well as the Forest Marble equivalents at outcrop in Boulogne, and (very rarely) from the Langrune Member at Lion-sur-mer and the St. Aubin Member at St. Aubin-sur-mer, Normandy Province.

ECOLOGY. Shallow water marine, occurring typically within a calcareous marl/limestone type facies.

REMARKS. When the ostracod zones used in this thesis were originally named (Sheppard, 1981) it was stated that M. falcata was found only within the Dorset and Kent-Boulonnais Provinces and was absent in Normandy. This statement must now be revised owing to the occurrence, albeit very rare, of the species within the horizons mentioned above in Normandy. This considerably strengthens the validity of the falcata Zone in U. Bathonian sediments south of the English Channel.

Micropneumatocythere quadrata Bate, 1967

(Pl. 14, fig. 2)

1967 Micropneumatocythere quadrata Bate, 58, pl. 19, figs. 11, 12; pl. 20, figs. 1 - 12.

1979 Micropneumatocythere quadrata Bate; Bate & Sheppard, 83, pl. 2, figs. 3, 4, 6.

DIAGNOSIS. Micropneumatocythere with subquadrate carapace (elongate in male dimorph); cardinal angles prominent, especially posterior angle. Postero-dorsal slope steeply angled; posteroventral slope broad and strongly convex. Shell surface smooth with widely-spaced pore canal openings. Ventral surface with distinct, parallel ridges.

MATERIAL. 20 valves.

DESCRIPTION. See Bate, 1967.

DISTRIBUTION. M. quadrata was originally described as an abundant species within the marine/brackish facies of the U. Estuarine Series of eastern England. Within the study area it occurs only in the U. Bathonian Forest Marble equivalent at Boulogne in the Kent-Boulonnais Province.

ECOLOGY. Shallow water marine to brackish, clay/marl facies. A euryhaline species, found usually within mixed water assemblages rather than purely marine.

REMARKS. M. quadrata is a very rare member of the Bathonian fauna in southern England, and south of the English Channel it occurs only in Boulonnais, in a higher part of the sequence than in eastern England (falcata Zone rather than polonica Zone). This implies a south/south easterly migration of the species, possibly around the shoreline of the London-Brabant Massif. The conditions in this southerly region were none too suitable, however, as evidenced by the absence of this species from the subsurface material in Kent. Water temperature may be an influencing factor in this case with the species preferring the supposedly slightly cooler northerly waters.

Micropneumatocythere subconcentrica (Jones, 1884)

(Pl. 14, figs. 3, 6)

Explanation of Plate 14.

Fig. 1. Micropneumatocythere falcata Sheppard, ♀ RV int., OS 11794 (.55 mm long, x 109), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.3.79).

Fig. 2. Micropneumatocythere quadrata Bate, ♀ RV, OS 11793 (.48 mm long, x 125), U. Bathonian, as above (F-BO.5.79).

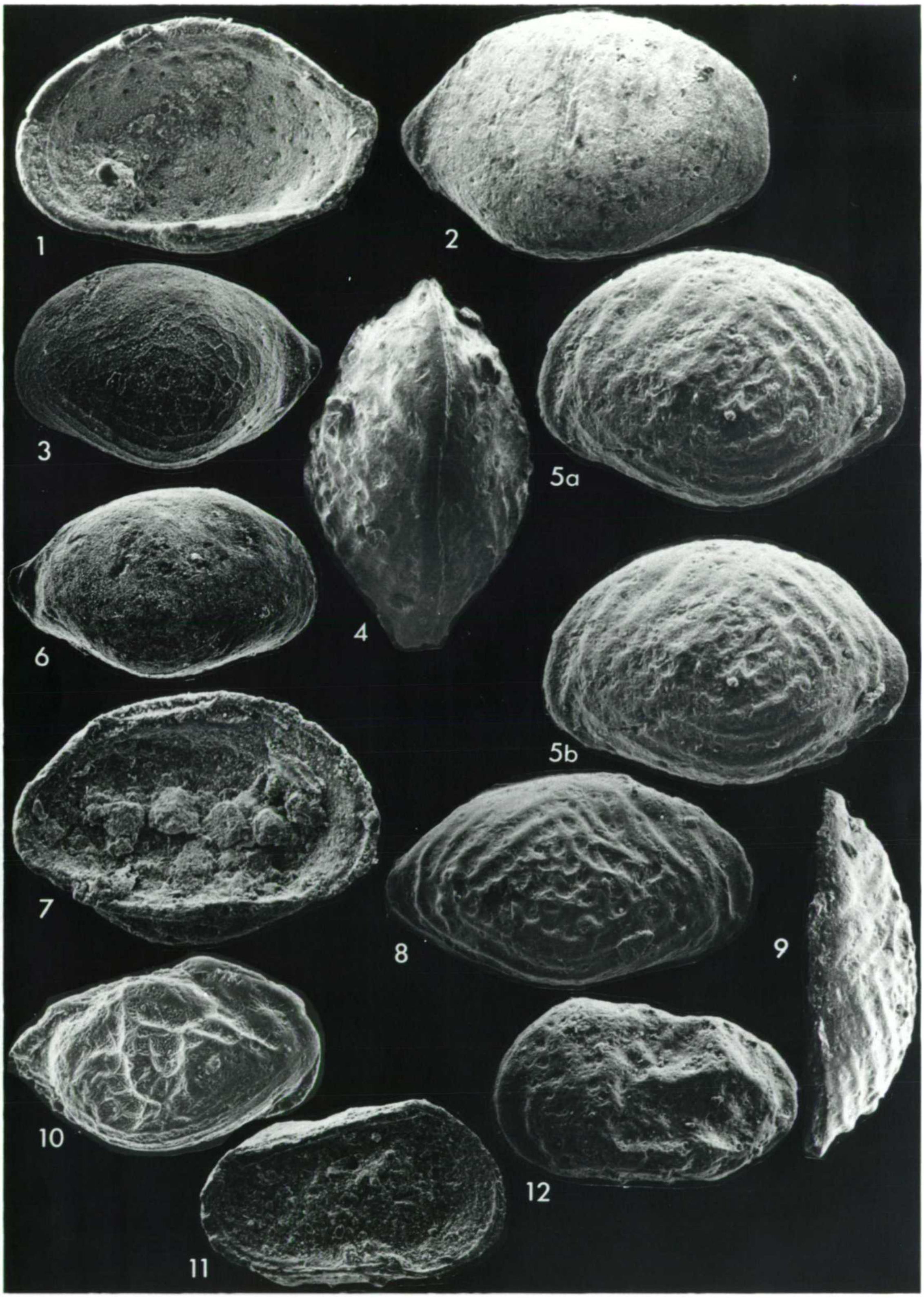
Figs. 3, 6. Micropneumatocythere subconcentrica Bate; fig. 3, ♀ LV, OS 11498 (.46 mm long, x 108), U. Bathonian, as above; fig. 6, ♀ RV, OS 11795 (.50 mm long, x 100), U. Bathonian, as above (F-BO.3.79).

Figs. 4, 5, 7 - 9. Micropneumatocythere triangula sp. nov.: fig. 4, ♂ car., dors., SAC 2386-C2 (.60 mm long, x 100), L. Bathonian, L. Fuller's Earth, depth 59.28 - 59.82 m, Frome borehole; fig. 5, stereo-pair of holotype, ♀ LV, SAC 2387-C1 (.56 mm long, x 107), L. Bathonian, as above, depth 59.82 - 60.25 m; fig. 7, ♀ LV int., SAC 2387-C3 (.57 mm long, x 105), L. Bathonian, as above; fig. 8, ♂ RV, SAC 2387-C2 (.64 mm long, x 93), L. Bathonian, as above; fig. 9, ♀ RV, dors., SAC 2386-C1 (.59 mm long, x 101), L. Bathonian, as above, depth 59.28 - 59.82 m.

Fig. 10. Dromacythere sagittata Ware & Whatley, ♀ car., R side, JM 1477-C1 (.41 mm long, x 121), U. Bathonian, Forest Marble, Calvert borehole.

Figs. 11, 12. Rectocythere sugillata (Jones & Sherborn), LV, OS 11810 (.50 mm long, x 100): fig. 11, int. lat.; fig.12, ext. lat., U. Bathonian, Langrune Member, Luc-sur-mer.

PLATE 14



1884 Cythere subconcentrica Jones, 768, pl. 34, figs. 28, 29.

1888 Cytheridea limaciformis Jones & Sherborn, 269, pl. 3, figs. 12a - c.

1979 Micropneumatocythere subconcentrica (Jones); Bate & Sheppard, 85, pl. 1, figs. 8, 9.

DIAGNOSIS. Micropneumatocythere with oval carapace (elongate in male dimorph). Ventral surface with longitudinal ridges extending onto ventrolateral margin and turning upwards anteriorly and posteriorly. Lateral surface with weak reticulation of striae or may appear smooth.

MATERIAL. 45 valves and carapaces.

DESCRIPTION. See Bate, 1967.

DISTRIBUTION. A widespread species recorded previously from the Great Oolite of Surrey (type-locality being the Richmond boring), the U. Estuarine Series of eastern England (Bate, 1967a), the Bradford Clay at Bradford, Somerset and U. Fuller's Earth at Midford, Somerset (both as M. limaciformis, see Bate 1969). Originally thought to be restricted to the U. Bathonian polonica and blakeana Ostracod Zones, M. subconcentrica is here further recorded from the falcata Zone within the Forest Marble and equivalents in the Kent-Boulonnais Province and from the Frome Clay and Forest Marble within the Dorset Province. These occurrences have therefore increased the known stratigraphical range upwards to include the highest Bathonian ostracod Zone, the falcata Zone.

ECOLOGY. A marine species of Micropneumatocythere, one of the least restricted species of the genus geographically and lithologically, occurring in low energy clay/marl facies and higher energy shallow water limestone facies.

REMARKS. Stratigraphically M. subconcentrica is useful only in terms of identifying sediments of U. Bathonian age, although the widespread nature of this species, in England at least, is very helpful in this respect.

The oval shape and faint surface reticulation serve to distinguish this from all other species of the genus.

Micropneumatocythere triangula sp. nov.

(Pl. 14, figs. 4, 5, 7 - 9)

1969 Micropneumatocythere? sp. cf. crassa Peterson; Dépêche, 111, pl. 3, fig. 1.

DERIVATION OF NAME. Latin, referring to arrangement of surface ridges.

DIAGNOSIS. Large species of Micropneumatocythere with surface ornamentation of shallow ridges paralleling ventral, anterodorsal and posterodorsal margins, forming a triangular pattern. Dimorphic.

MATERIAL. 17 valves, 6 carapaces.

HOLOTYPE. Female left valve, SAC 2387-C1, L. Bathonian, L. Fuller's Earth, Frome borehole, depth 59.82 - 60.25 m, Dorset Province.

DESCRIPTION. Carapace oval, large (♀ length .56 mm, ♂ length .64 mm), inflated, with greatest height and width occurring medially and greatest length just below mid point. Anterior margin rounded, posterior margin tapering to small caudal process. Ventrolateral border of each valve strongly convex, projecting slightly below ventral surface, particularly midventrally. Marginal borders lightly compressed. Anteriorly an oblique furrow extends from anterior cardinal angle down towards anteroventral margin. Surface ornamented by a series of ridges parallelling ventral, posterodorsal and anterodorsal margins, forming a distinct triangle, with well developed reticulation in valve centre. Several longitudinal ridges developed along ventral surfaces of valves. LV larger than RV which it overreaches along dorsal margin and overlaps slightly along ventral margin. Ventral margin convex with an anteromedian incurvature. Cardinal angles more pronounced in male dimorph; in female dimorph anterior cardinal angle is indistinct.

Hinge antimerodont with, in LV, terminal loculate sockets bearing 5 or 6 teeth and a median denticulate bar with an accommodation groove above. Inner margin and line of concrescence coincide. Marginal pore canals straight, widely spaced; precise number not known. A distinct selvage is present around anterior margin. Muscle scars not observed.

DISTRIBUTION. Recorded previously by Dépêche from L. Bathonian of Lorraine, N.E. Paris Basin. Herein known from the L. Bathonian L.

Fuller's Earth at the type locality, and from U. Bathonian topmost Forest Marble and lowermost Cornbrash within several borehole sequences in the Kent-Boulonnais Province.

DIMENSIONS.

			L	H	W	Depth (m)
holotype,	♀ LV,	SAC 2387-C1	.56	.38		59.82-60.25
paratypes:	♂ RV,	SAC 2387-C2	.64	.36		"
	♀ LV,	SAC 2387-C3	.57	.38		"
	♀ RV,	SAC 2386-C1	.59	.35		59.28-59.82
	♂ car.,	SAC 2386-C2	.60	.39	.38	"

ECOLOGY. Shallow water marine, marl facies.

REMARKS. This is a particularly large species of Micropneumatocythere but is not, however, large enough to be included within the Bajocian genus Pneumatocythere Bate, 1963. It bears a very close resemblance to the N. American Callovian species, M. crassa (Peterson) described by Sherrington and Lord (1975) but in that species the surface ornamentation is of a simple reticulate arrangement of ridges.

The diagnostic triangular ornament in M. triangula is one which is seen in several species of Acanthocythere. The convex dorsal margin, greatly swollen carapace, small caudal process and ventrolateral overhang of the valves are, however, so typical of Micropneumatocythere to which it is assigned. The similarity in surface ornament between unrelated genera, which is repeatedly seen in Bathonian ostracods, is possibly the result of mimicry between the individuals, although it is particularly difficult to prove in this case as M. triangula is not a widespread species, nor does it occur in the same samples in association with species of Acanthocythere.

The appearance of M. triangula both in L. Bathonian and topmost U. Bathonian means that it is of limited use stratigraphically, its importance is one of evolutionary significance, representing one of the first Bathonian species of the genus, certainly the earliest highly ornate Bathonian species.

Genus Dromacythere Ware & Whatley, 1980

Dromacythere sagittata Ware & Whatley, 1980

(Pl. 14, fig. 10)

1980 Dromacythere sagittata Ware & Whatley, 210, pl. 4, figs. a - h.

DIAGNOSIS. Dromacythere with delicate surface reticulation and three short ridges meeting at dorsomedian umbo. Strong ventrolateral tumidity.

MATERIAL. 2 carapaces only.

DESCRIPTION. See Ware & Whatley, 1980.

DISTRIBUTION. D. sagittata has previously been described only from the type locality and horizon; Kirtlington, Oxfordshire, U. Bathonian Forest Marble (falcata Ostracod Zone). Herein it is recorded from the Forest Marble (falcata Zone) of the Calvert borehole only, within the Kent-Boulonnais Province.

ECOLOGY. Shallow water marine, preferring a carbonate environment.

REMARKS. This is the first record of the species since its recent description in 1980, and serves as a useful marker both stratigraphically and ecologically. A marine species, D. sagittata is presumed to have inhabited very shallow waters with close proximity to land evidenced by suncracks, breaks in sedimentation and sandy horizons of the shoreline facies in Kent, and by the abundant plant remains and charophyte gyrogonia found in Oxfordshire. Although the species is particularly rare its occurrence in the Calvert borehole material is useful in correlating that horizon in Buckinghamshire with the Forest Marble in Kirtlington.

The loan of specimens of D. sagittata from Dr. M. Ware is here acknowledged.

Genus Rectocythere Malz, 1958

Rectocythere sugillata (Jones & Sherborn, 1888)

(Pl. 14, figs. 11, 12)

1888 Cytheridea sugillata Jones & Sherborn, 262, pl. 2, figs. 2a - c.

1969 Rectocythere sugillata Jones & Sherborn; Bate, 409, pl. 10, figs. 3 - 6.

DIAGNOSIS. Rectocythere with surface ornamentation of irregular ridges and swellings. Coarsely pitted shell surface.
MATERIAL. 19 valves and carapaces.
DESCRIPTION. See Bate, 1969.
DISTRIBUTION. R. sugillata has previously been recorded from the U. Bathonian U. Fuller's Earth of the Bath area of southern England only. It is here further recorded from the Normandy Province from the U. Bathonian St. Aubin and Langrune Members (falcata Zone) of the coastal region.
ECOLOGY. A marine species, favouring a carbonate environment.
REMARKS. This species is restricted to U. Bathonian sediments of blakeana and falcata Ostracod Zones only and, as such, is a useful stratigraphic marker. It is absent from the U. Bathonian of the Kent-Boulonnais Province, suggesting that the water was too shallow here.

Genus Acanthocythere Sylvester-Bradley, 1956.

DIAGNOSIS (emended). Shell subrectangular, convex in dorsal view, surface more or less spiny, with or without prominent rounded eye tubercles. Hinge antimerodont or lobodont.
TYPE SPECIES. Cythere sphaerulata Jones & Sherborn, 1888.
REMARKS. The presence of a prominent eye tubercle has, until now, been regarded as a diagnostic feature of the genus. The discovery of a species, similar in all respects to the type species but lacking the eye tubercle, has necessitated a revised diagnosis for the genus and the erection of a new subgenus, Blanoacanthocythere. There are consequently now 3 subgenera:
Acanthocythere (Acanthocythere), type-species A. (A.) sphaerulata (Jones & Sherborn, 1888)
Acanthocythere (Protoacanthocythere), type-species A. (P.) faveolata Bate, 1963
Acanthocythere (Blanoacanthocythere), type-species A. (B.) magna sp.nov.

Acanthocythere (Acanthocythere) sphaerulata
(Jones & Sherborn, 1888)
(Pl. 15, figs. 1 - 3, 5)

1888 Cythere sphaerulata Jones & Sherborn, 253, pl. 1, figs. 6a - c.

1956 Acanthocythere sphaerulata (Jones & Sherborn); Sylvester-Bradley, 12, pl. 1, figs. 1 - 4.

1969 Acanthocythere sphaerulata (Jones & Sherborn); Bate, 411, pl. 11, figs. 4 - 6.

DIAGNOSIS. Carapace oblong, swollen, ornamented with closely-set short blunt spines arranged in a faint reticulate pattern.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Sylvester-Bradley, 1956.

DISTRIBUTION. Previously recorded from the U. Fuller's Earth at Midford Bath, southern England (type-locality); herein it forms a common faunal element within L. to U. Bathonian sediments at several localities in the Normandy Province, and the U. Bathonian Forest Marble of the Dorset Province.

ECOLOGY. Shallow water marine, preferring, though not restricted to, a limestone facies.

REMARKS. This is a very common faunal element particularly within the U. Bathonian limestone sequences of Normandy where it commonly occurs in association with bairdiids, schulerideids and cytherellids. A large robust species, A. sphaerulata is well suited to a relatively high energy environment, where the reticulate arrangement of very short blunt spines would significantly reinforce the shell.

Acanthocythere (Acanthocythere) spiniscutulata
Sylvester-Bradley, 1956.
(Pl.15, figs.4,6 - 9)

1956 Acanthocythere spiniscutulata Sylvester-Bradley, 13, pl. 1, figs. 5 - 9.

DIAGNOSIS. Subrectangular carapace, tapering posteriorly; with prominent cardinal angles and ornamentation of ridges arranged in triangular or diamond-

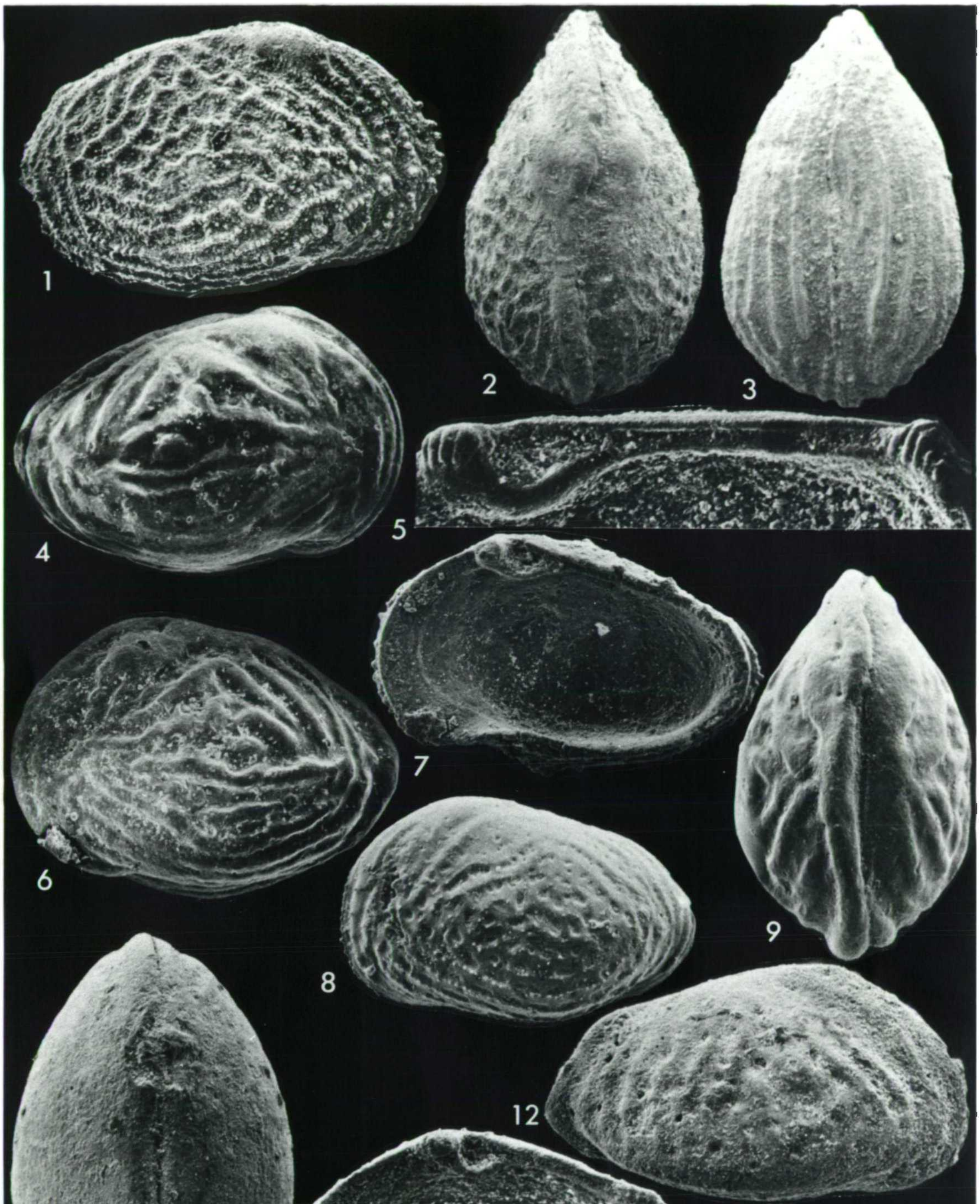
Explanation of Plate 15

Figs. 1-3, 5. Acanthocythere (A.) sphaerulata (Jones & Sherborn): fig. 1, ♀ RV, OS 11502 (.62 mm long, x 96); fig. 2, ♀ car., dors., OS 11791 (.59 mm long, x 101); fig. 3, ♀ car., vent., OS 11790 (.56 mm long, x 107); fig. 5, ♀ RV int., hinge, OS 11792 (x 200). All from U. Bathonian, St. Aubin Member, St. Aubin-sur-mer (F-SA.2.78).

Figs. 4, 6 - 9. Acanthocythere (A.) spiniscutulata Sylvester-Bradley: fig. 4, ♀ car., R side, OS 11620 (.59 mm long, x 101), U. Bathonian, Campagnettes Member, Ranville Cement Works (F-R.3A.78); figs. 6, 9, ♀ car., OS 11619 (.60 mm long, x 100); fig. 6, L side; fig. 9, dors., U. Bathonian, as above; fig. 7, ♀ RV int., OS 11782 (.58 mm long, x 103), U. Bathonian, as above; fig. 8, juv. LV, OS 11621 (.50 mm long, x 110), U. Bathonian, St. Aubin Member, Reviers (F-Re.8.78).

Figs. 10 - 12. Acanthocythere (Blanoacanthocythere) magna subgen. et sp. nov.: fig. 10, juv. car., dors., OS 11785 (.60 mm long, x 108), U. Bathonian, Campagnettes Member, Carrière des Campagnettes, Ranville (F-R.16A.78); fig. 11, RV int., OS 11787 (.69 mm long, x 94), U. Bathonian, Campagnettes Member, Ranville Cement Works (F-R.4.78); fig. 12, RV, OS 11786 (.69 mm long, x 94), U. Bathonian, as above.

PLATE 15



shaped pattern.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Sylvester-Bradley, 1956.

DISTRIBUTION. Known from the U. Fuller's Earth, recorded previously from Midford, Bath, southern England (type-locality) and herein from the Seabarn Farm borehole, Dorset Province, and from several horizons within the U. Bathonian of the Normandy Province.

ECOLOGY. Shallow water marine, limestone/marl facies.

REMARKS. Like A. sphaerulata, this species is also a very common faunal element particularly within the U. Bathonian sediments of Normandy where the robust thick-shelled carapace was ideally suited to the high-energy shallow water environments. The coarse triangular ornamentation of ridges in this species serves to distinguish it from all others.

Subgenus Blanoacanthocythere nov.

DERIVATION OF NAME. Greek blanos, meaning blind.

DIAGNOSIS. A subgenus of the genus Acanthocythere in which eye tubercles are absent.

TYPE SPECIES. Acanthocythere (Blanoacanthocythere) magna sp. nov.

Acanthocythere (Blanoacanthocythere) magna sp. nov.
(Pl. 15, figs. 10 - 12; pl. 16, figs. 1, 2)

DERIVATION OF NAME. Latin, referring to large carapace size.

DIAGNOSIS. A large species of Blanoacanthocythere in which carapace tapers strongly to posterior with ventrolateral overhang of valves. Faint surface ornamentation of ridges in a triangular pattern.

MATERIAL. 22 valves and carapaces.

HOLOYPE. Carapace, OS 11783, U. Bathonian Ranville Member cross-bedded limestones, Reviers, Normandy.

DESCRIPTION. Large subrectangular carapace, tapering posteriorly.

Anterior margin broadly rounded, low positioned posterior margin small, acuminate. Dorsal margin straight with sharply pronounced cardinal angles, ventral margin more or less straight with anteromedian incurvature. Maximum height passes through anterior cardinal angle; maximum length occurs below mid-point; maximum width in posterior third. Carapace greatly swollen when viewed dorsally with considerable ventrolateral overhang of valves below ventral surface.

Shell surface ornamented by a faint triangular arrangement of shallow ridges which parallel ventral, anterodorsal and posterodorsal margins. Eye tubercle lacking. LV slightly larger than RV which it overreaches along dorsal and around posterior margins. Non dimorphic.

Hinge lobodont. Inner margin and line of concrescence coincide. Marginal zone of moderate width with numerous straight, evenly spaced marginal pore canals. Muscle scars not observed.

DISTRIBUTION. Known from the Normandy Province, from U. Bathonian sediments, Ranville Member and Campagnettes Member (blakeana Zone) at Reviers and Ranville, and from the U. Bathonian Forest Marble within several borehole sequences in the Kent-Boulonnais Province.

DIMENSIONS

			L	H	W	Locality
holotype,	car.,	OS 11783	.75	.45	.49	F-Re.13A.78
paratypes:	RV,	OS 11784	.76	.42		F-R.3A.78
juv.	car.,	OS 11785	.60	.37	.42	F-R.16A.78
	RV,	OS 11786	.69	.39		F-R.4.78
	RV,	OS 11787	.69	.40		F-R.4.78
	car.,	OS 11798	.76	.44	.48	F-R.1.79

ECOLOGY. Shallow water marine, inhabiting both clay and limestone facies.

REMARKS. This is the first record of a species of Acanthocythere without eye tubercles. Despite this, one cannot automatically assume that this species was actually blind. It occurs in similar shallow water, near-shore sediments as the eyed species where, presumably, eyes would have been advantageous.

Explanation of Plate 16

Figs. 1, 2. Acanthocythere (Blanoacanthocythere) magna subgen. et sp. nov., holotype, car., OS 11783 (.75 mm long, x 86); fig. 1, R side; fig. 2, stereo-pair of L side, U. Bathonian, Ranville Member, Reviers (F-Re.13A.78).

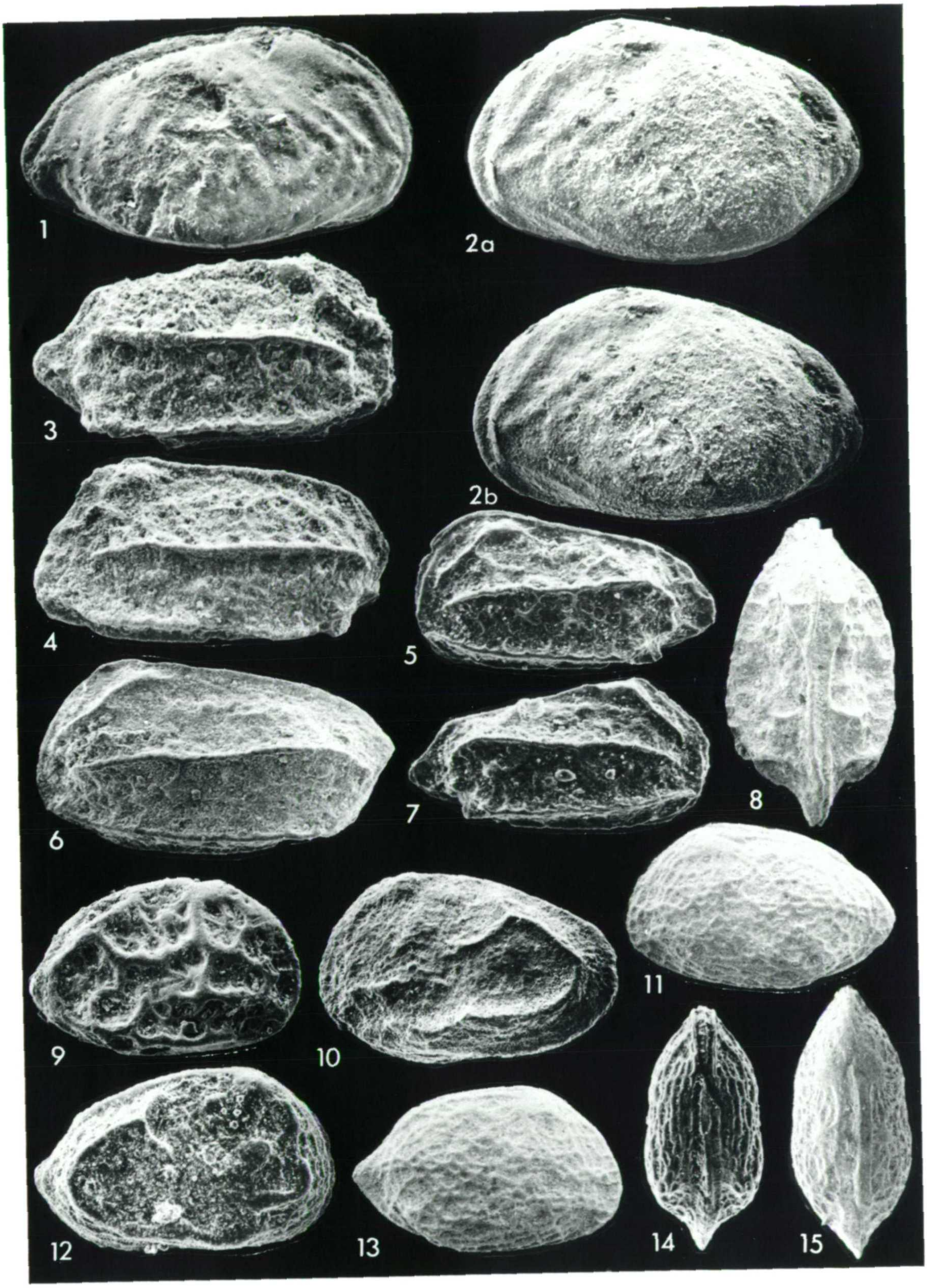
Figs. 3 - 8. Palaeocytheridea carinilia (Sylvester-Bradley): fig. 3, RV, OS 11608 (.53 mm long, x 113), U. Bathonian, Campagnettes Member, Ranville Cement Works (F-R.3A.78); fig. 4, LV, OS 11607 (.59 mm long, x 101), U. Bathonian, St. Aubin Member, Bénouville (F-B.2A.78); figs. 5, 8, juv. car., OS 11610 (.39 mm long, x 128): fig. 5, L side; fig. 8, dors., M. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.26.78); fig. 6, LV, MPA 1978-C1 (.59 mm long, x 101), U. Bathonian, Forest Marble, depth 732.14 - 732.70 m, Winterborne Kingston borehole; fig. 7, juv. RV, OS 11609 (.39 mm long, x 128), M. Bathonian, Marnes de Port-en-Bessin (F-PB.19.78).

Fig. 9. Hekistocythere venosa Bate, juv. RV, OS 11805 (.29 mm long, x 155), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.1.79).

Figs. 10, 12. Hekistocythere micropunctata Ware & Whatley: fig. 10, juv. car., L side, MPA 4825-C1 (.37 mm long, x 135), U. Bathonian, Forest Marble, depth 66.50 m, Seabarn Farm borehole; fig. 12, juv. RV, BM 5517-C1 (.39 mm long, x 128), U. Bathonian, Forest Marble, St. Margaret's Bay borehole.

Figs. 11, 13 - 15. Hekistocythere anastomosis sp. nov.: figs. 11, 14 car., OS 11801 (.34 mm long, x 150): fig. 11, L side; fig. 14, vent., M. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, (F-PB.23.78); fig. 13, RV, OS 11802 (.34 mm long, x 132), M. Bathonian, as above (F-PB.19.78); fig. 15, car., dors., OS 11800 (.36 mm long, x 125), M. Bathonian, as above.

PLATE 16



Genus *Palaeocytheridea* Mandelstam, 1947

DIAGNOSIS (emended) Subquadrate carapace with two distinct longitudinal lateral carinae and one ventral carina. Further minor carinae often present. Shell surface variously ornamented by reticulae or tubercles. Cardinal angles pronounced. Eye node present. Hinge variable. Marginal pore canals few and straight.

TYPE SPECIES. *Palaeocytheridea bakirovi* Mandelstam, 1947.

REMARKS. *Palaeocytheridea* is here restricted to include only those species possessing the diagnostic longitudinal carinae. Numerous species of the genus have been erected by various authors, in particular by Ljubimova and Kabarova (1955) working on Jurassic and Cretaceous faunas from the Volga-Ural region of Russia, which are not true *Palaeocytheridea* species. A revision of some of these forms has been carried out by Fuller and Lord (1979) when they assigned 4 such species to the genus *Galliaecytheridea*.

Palaeocytheridea s.s. is a M. Jurassic genus, ranging from L. Bathonian to M. Callovian.

Palaeocytheridea was placed by Whatley (1970) in the subfamily Pleurocytherinae on account of its similarity to *Pleurocythere* Triebel, 1951. This is not upheld here as *Palaeocytheridea* would appear to have greater affinities to the progonocytherids (see the Remarks section for the genus *Pleurocythere*).

The genus is here represented by one species only, *P. carinilia* (Sylvester-Bradley, 1948).

Palaeocytheridea carinilia (Sylvester-Bradley, 1948)
(Pl. 16, figs. 3 - 8)

1948 *Lophocythere carinilia* Sylvester-Bradley, 197, pl. 13, figs. 6, 7; pl. 14, figs. 5, 6.

1969 *Palaeocytheridea parabakirovi* Malz; Dépêche, 112, pl. 3, fig. 3.

1981 *Palaeocytheridea carinilia* (Sylvester-Bradley); Bate & Sheppard (in press).

DIAGNOSIS. Subrectangular Palaeocytheridea with two major lateral carinae, a short anterodorsal carina running from near mid-point of anterior margin to eye tubercle, a subventral carina running along length of carapace, forming ventral border and a short posterodorsal carina, sometimes developed, running upwards as a branch from posterior end of median carina. Shell surface reticulate. Hinge entomodont.
MATERIAL. Over 100 valves and carapaces, largely juvenile.
DESCRIPTION. See Sylvester-Bradley, 1948.
DISTRIBUTION. Apart from the type horizon and locality of the U. Bathonian bcueti Bed at Langton Herring, Dorset, this has been further recorded from the L. Fuller's Earth, Fuller's Earth Rock and the U. Fuller's Earth of the Bath area of southern England (as P. parabakirovi of Dépêche, 1969 in Bate, 1979, fig. 5), from the U. Bathonian Frome Clay in Dorset (Bate & Sheppard, 1981) and in France from the L. Bathonian of the Lorraine region (as P. parabakirovi Malz, 1962). Herein, recorded from U. Bathonian of the Dorset Province and from L. to U. Bathonian at several localities in the Normandy Province.
ECOLOGY. Marine, shallow water, clay/marl and limestone facies.
REMARKS. P. carinilia is morphologically very close to the Callovian species P. parabakirovi Malz, 1962 from NW Germany and in fact P. carinilia has been mistaken for P. parabakirovi in the past (e.g. Dépêche, 1969 and Bate, 1979). In P. parabakirovi the anterodorsal carina commences further back from the anterior margin up to the eye tubercle and is not so pronounced as in P. carinilia. Also, a further short stout carina is developed connecting the median part of the anterodorsal carina and the median lateral carina; this is often developed in P. carinilia but very poorly so. In P. parabakirovi there is a tendency for the reticulae to develop into small blunt tubercles; this is never seen in P. carinilia. The close similarity in the 2 species does imply a phylogenetic relationship with P. parabakirovi evolving from P. carinilia at the beginning of the Callovian Stage. The loan of type specimens of P. parabakirovi from Dr. H. Malz of the Senckenberg Museum for direct comparative purposes is here acknowledged.

Juvenile stages of P. carinilia far outnumber adults in every sample containing the species. Juveniles are easily recognised, not only by smaller size, but by tapering considerably towards the posterior (e.g. that figured by Dépêche in 1969, pl. 3, fig. 3).

Genus Hekistocythere Bate, 1969

REMARKS. With the exception of two presumed Tithonian species, H. microreticulata and H. inaequicosta both Pokorny, 1973, Hekistocythere is essentially a Bathonian genus. Three new species are presented here, making a total of eight for the genus, of which five, including the type-species H. venosa Bate, 1969, occur within the study area.

Hekistocythere venosa Bate, 1969

(Pl. 16, fig. 9)

1969 Hekistocythere venosa Bate, 428, pl. 14, figs. 2, 4, 9; pl. 15, fig. 7.

1980 Hekistocythere venosa Bate; Ware & Whatley, pl. 3, figs. a - f.

DIAGNOSIS. Hekistocythere with strongly ornamented carapace. Broad diagonal ridge extends from posterodorsal to anteroventral region of valve. Short, stout ridges given off on dorsal and ventral sides of main ridge. Smaller intermediary ridges producing a reticulate ornamentation.

MATERIAL. 4 valves only.

DESCRIPTION. See Bate, 1969.

DISTRIBUTION. Originally described from the U. Fuller's Earth of Bath and later from the Fuller's Earth Rock to U. Fuller's Earth (Bate, 1979) this species has since been recorded from the U. Bathonian Forest Marble (falcata Zone) of Oxfordshire (Ware & Whatley, 1980). In the study area it occurs within the Kent-Boulonnais Province only, from the Forest Marble of the St. Margaret's Bay borehole and equivalent beds of "Les Pichottes" Quarry, Boulogne.

ECOLOGY. Marine, shallow water, recorded from fine-grained clays to coarse rubbly limestones.

REMARKS. This is a particularly rare member of the fauna in the study area. In the SW of England it is present only to the N of the Mendip Axis in the Bath area from the Fuller's Earth Rock period (confossa Zone). Possible dispersal eastwards is evidenced by the species' occurrence in Oxfordshire and the Kent-Boulonnais Province in beds of a younger age, but southerly movement into Dorset and ultimately Normandy does not occur.

H. venosa has a similar ornamentation pattern to H. inaequicosta Pokorny, 1973 from the presumed Tithonian of Czechoslovakia. In this species, however, the broad diagonal ridge extending from the posterodorsal to the anteroventral region is discontinuous in the central part of the valve, and there is a finer reticulate network over the valve surface than in H. venosa.

Hekistocythere micropunctata Ware & Whatley, 1980
(Pl. 16, figs. 10, 12)

1980 Hekistocythere micropunctata Ware & Whatley, 207, pl. 2, figs. i - n.

DIAGNOSIS. Large species of Hekistocythere with a very fine, dense, punctate ornament; distinct eye spot. Wide inner marginal zones.

MATERIAL. 8 juvenile valves and carapaces.

DESCRIPTION. See Ware & Whatley, 1980.

DISTRIBUTION. Originally described from the U. Bathonian Forest Marble of Oxfordshire, it is here further recorded from the Forest Marble (falcata Zone) of the Seabarn Farm borehole, Dorset and the Forest Marble of the St. Margaret's Bay borehole, Kent.

ECOLOGY. Shallow water marine.

REMARKS. This is a rare species in the present material and occurs only as juvenile forms. Due to the relatively poor state of preservation the finely punctate ornament is not too clear. The posterodorsal and postero-ventral ridges, which Ware and Whatley state may be more strongly expressed in penultimate instars than in adults, are nevertheless prominent. Adults have been recorded as being approximately .48 mm long; the present material ranges between .37 and .39 mm in length which Ware and Whatley regard as the size for the -1 instar.

The occurrence of H. micropunctata in the study area is useful in demonstrating the existence of the species over a reasonably wide geographical area; it has hitherto been recorded from only a single quarry section. Although very rare it is a useful marker for the U. Bathonian falcata Zone.

Hekistocythere anastomosis sp. nov.

(Pl. 16, figs. 13 - 15; pl. 17, figs. 1 - 4)

DERIVATION OF NAME. Greek, referring to anastomosing pattern of ridges forming a surface reticulation.

DIAGNOSIS. Hekistocythere with irregular reticulate network of ridges over entire shell surface apart from smooth eye node.

MATERIAL. Over 100 valves and carapaces.

HOLOTYPE. Carapace, OS 11799, M. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.

DESCRIPTION. Oval carapace with rounded anterior margin, triangular posterior margin with small caudal process and gently convex dorsal and ventral margins with slight ventrolateral overhang of valves in posterior third. Greatest length of carapace occurs through mid-point, greatest height in anterior third and greatest width in posterior third. When viewed dorsally there is a slight median concavity of valves. LV larger than RV which it overlaps along ventral margin; RV overreaches LV along dorsal margin. Reticulate ornamentation over entire valve surface apart from smooth eye node immediately below anterior cardinal angle.

Hinge lophodont: RV with crenulate terminal elements which are dorsal terminations of the selvage; median groove narrow and deeply recessed, smooth, weakly convex. LV with opposing elements of terminal loculate sockets open ventrally to valve with smooth median bar. Inner margin and line of concrescence coincide; marginal zone rather narrow. Marginal pore canals short, straight and widely spaced, 7 or 8 anteriorly and 3 or 4 posteriorly. Muscle scars not observed.

Sexual dimorphism not observed.

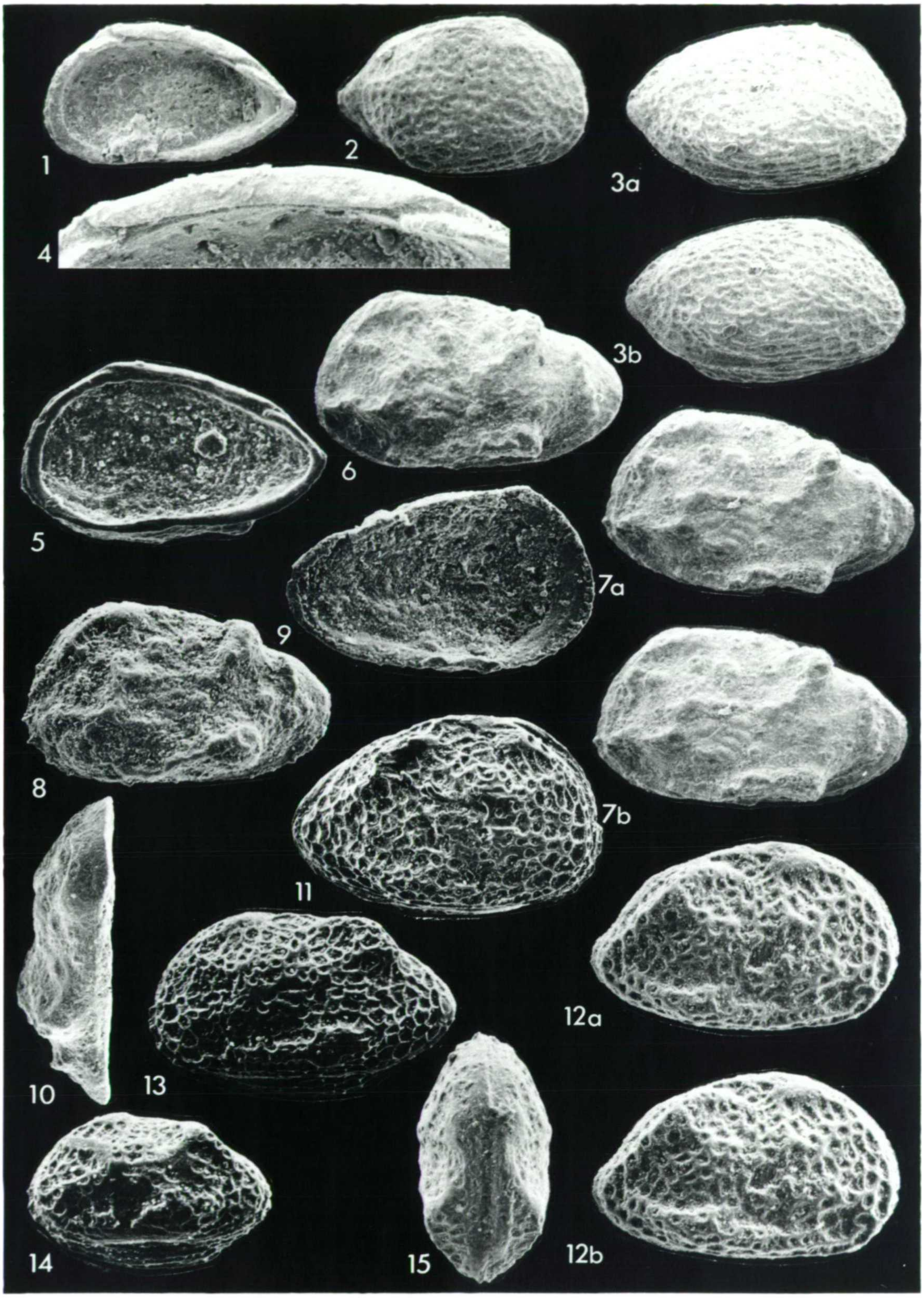
Explanation of Plate 17

Figs. 1 - 4. Hekistocythere anastomosis sp. nov.: figs. 1, 4, RV, OS 11802 (.34 mm long): fig. 1, int. lat. (x 117): fig. 4, hinge (x 750), M. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.19.78); fig. 2, juv. RV, OS 11804 (.25 mm long, x 160), M. Bathonian, as above; fig. 3, stereo-pair of holotype, car., R side (.34 mm long, x 138), M. Bathonian, as above.

Figs. 5 - 10. Hekistocythere pustulosa sp. nov.: fig. 5, RV int., OS 11829 (.35 mm long, x 142), M. Bathonian, Marnes de Port-en-Bessin (F-PB.19.78); fig. 6, LV, OS 11808 (.36 mm long, x 138), L. Bathonian, Marnes de Port-en-Bessin (F-PB.48.78); fig. 7, stereo-pair of holotype, LV, OS 11806 (.41 mm long, x 121), L. Bathonian, as above (F-PB.38.78); figs. 8, 10, LV, OS 11830 (.37 mm long, x 135): fig. 8, ext. lat.; fig. 10, dors., M. Bathonian, as above (F-PB.19.78); fig. 9, LV int., OS 11807 (.39 mm long, x 128), M. Bathonian, as above (F-PB.20.78).

Fogs. 11 - 15. Hekistocythere reticulata sp. nov.: figs. 11, 13, car., OS 11832 (.33 mm long, x 150): fig. 11, R side; fig. 13, L side, U. Bathonian, St. Aubin Member, St. Aubin-sur-mer (F-SA.2.78); fig. 12, stereo-pair of holotype, RV, OS 11831 (.32 mm long, x 156), U. Bathonian, as above (F-SA.7.78); figs. 14, 15, juv. car., OS 11833 (.27 mm long): fig. 14, L side (x 148); fig. 15, dors. (x 148), U. Bathonian, Langrune Member, Luc-sur-mer (F-L.2.78).

PLATE 17



DISTRIBUTION. Found only at the type locality, towards the top of the sequence of Marnes de Port-en-Bessin, representing topmost L. Bathonian and lowermost M. Bathonian.

DIMENSIONS.

			L	H	W	Sample
holotype,	car.,	OS 11799	.34	.21	.17	F-PB.19.78
paratypes:	car.,	OS 11800	.36	.21	.18	"
	car.,	OS 11801	.34	.21	.17	F-PB.23.78
	RV.,	OS 11802	.34	.21		F-PB.19.78
	car.,	OS 11803	.36	.22	.17	"
juv.	RV,	OS 11804	.25	.16		"

ECOLOGY. Marine, relatively low energy environment, occurring within a marl facies.

REMARKS. The irregular close-spaced reticulate ornament of this species is quite distinct from any previously described for the genus. The hinge in H. anastomosis is distinct also in having crenulate terminal elements such that in the right valve, posteriorly at least, the terminal bar is divided into several small toothlets. In all other species these elements are undivided, with the exception of H. micropunctata Ware and Whatley, 1980 whose anterior terminal element is described as sometimes 'corrugate'.

Hekistocythere pustulosa sp. nov.

(Pl. 17, figs. 5 -10)

DERIVATION OF NAME. Latin, meaning 'full of blisters', referring to the numerous small, irregular swellings over the carapace.

DIAGNOSIS. Carapace with prominent posterodorsal ridge extending irregularly to anteroventral position. A shorter prominent posteroventral ridge. Further short node-like irregular swellings over carapace.

MATERIAL. 25 valves.

HOLOTYPE. Left valve, OS 11806, L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.

DESCRIPTION. Oval carapace with rounded anterior and posterior margins, gently convex dorsal and ventral margins. Posterior margin laterally compressed. Line of greatest length passes through mid-point, greatest height in anterior third and greatest width in posterior third. Surface ridges as for diagnosis. Posteroventral ridge forms small keel-like structure. Smooth rounded eye node just below anterior cardinal angle. Numerous large normal pore canal openings with raised collars scattered over shell surface. A very fine reticulation covers entire shell surface. Anterior and posterior margins often dentate.

Muscle scars, observable from exterior, a subvertical row of 4 elongate-oval adductors with an anterodorsally situated kidney-shaped frontal scar.

Hinge lophodont: RV with terminal ridges, anterior one of which is slightly differentiated but essentially both are smooth; median groove deep, narrow, slightly convex. LV with opposing elements. Inner margin and line of concrescence coincide; narrow marginal zone, pore canals not observed.

Sexual dimorphism not observed.

DISTRIBUTION. H. pustulosa occurs only in the Normandy Province where it has a long vertical range. Although never a common element of the fauna it is here recorded from L., M. and U. Bathonian sediments at several localities (rimosa to falcata Zones).

DIMENSIONS.

			L	H	Locality
holotype,	LV,	OS 11806	.41	.24	F-PB.38.78
paratypes:	RV,	OS 11807	.39	.23	F-PB.20.78
	LV,	OS 11808	.36	.23	F-PB.48.78
juv.	LV,	OS 11809	.29	.17	"
	RV,	OS 11829	.35	.22	F-PB.19.78
	LV,	OS 11830	.37	.23	F-PB.46.78

ECOLOGY. Marine, inhabiting a wide variety of shallow water shelf environments.

REMARKS. H. pustulosa has the same basic ornamentation as H. venosa Bate, 1969 with the major ridge extending from the posterodorsal corner to the anteroventral region of the valve. In H. venosa, however, the ridge is more strongly developed with short lateral ridges coming off it that are lacking in H. pustulosa. The posteroventral ridge, present in both species, is more pronounced in the latter, giving a slight angularity to the ventral outline.

Hekistocythere reticulata sp. nov.

(Pl. 17, figs. 11 - 15)

DERIVATION OF NAME. Latin, referring to the surface ornament.
DIAGNOSIS. Hekistocythere with coarse reticulate network over surface; short curved ridges posteroventrally and posterodorsally; smooth eye node.
MATERIAL. 1 valve, 2 carapaces only.
HOLOTYPE. Right valve, OS 11831, U. Bathonian St. Aubin Member limestones, St. Aubin-sur-mer, Normandy.
DESCRIPTION. Oval carapace with broadly rounded anterior margin, tapering posterior margin; dorsal and ventral margins uniformly convex. Line of greatest length passes through valve centre; greatest height passes through anterior cardinal angle; greatest width in posterior third. Anterior and posterior cardinal angles well rounded. A short curved ridge situated posteroventrally continues along ventrolateral edge of valve, overhanging ventral margin slightly. A similar curved ridge present in posterodorsal position, giving angularity to dorsal margin. Valve surface covered, apart from smooth eye node, by a coarse reticulate network of murae which is more regular around valve margins. LV larger than RV which it overlaps along ventral margin and overreaches around anterior and posterior margins; RV overreaches LV along dorsal margin.

Muscle scars, observable from exterior, a subvertical row of 4 elongate oval adductors and an anterodorsal frontal scar of indeterminate shape.

Inner margin and line of concrescence coincident with narrow marginal zone; pore canals not observed. Hinge lophodont; terminal elements of RV hinge formed by the smooth expanded terminations of selvage. Median groove narrow and deeply recessed, smooth, weakly convex. LV with opposing elements. Sexual dimorphism not observed.

DISTRIBUTION. Known only from the Normandy Province; from the U. Bathonian St. Aubin Member at St. Aubin and the U. Bathonian Langrune Member (both falcata Zone) at Lion-sur-Mer.

DIMENSIONS.

	L	H	W	Locality
holotype, RV, OS 11831	.32	.20		F-SA.7.78
paratypes: car., OS 11832	.33	.21	.18	F-SA.2.78
juv car, OS 11833	.27	.17	.14	F-L.2.78

ECOLOGY. Marine, very shallow water, sublittoral to littoral, high energy carbonate environment.

REMARKS. H. reticulata is similar in shape and dimensions to another reticulate species, H. anastomosis sp. nov. The reticulation in the latter species is not as coarse as in H. reticulata and is more irregular, also the posterodorsal and posteroventral ridges which are a prominent feature of H. anastomosis are totally lacking. These ridges are also found in H. pustulosa sp. nov. suggesting that H. reticulata evolved from that species with an accompanying reduction in surface nodes and an exaggeration of the already-present faint reticulation. A comparison of the juvenile stages of these 2 forms reveals an even greater morphological similarity than exists between the adults, suggesting a strong phylogenetic relationship. In the juveniles of H. reticulata, in addition to the posteroventral and posterodorsal ridges there are also traces of the posterodorsal ridge extending down irregularly to the anteroventral corner of the carapace as found in H. pustulosa.

Genus Marslatourella Malz, 1959

Marslatourella bullata Bate, 1967

(Pl. 18, figs. 1, 2)

1967 Marslatourella bullata Bate, 56, pl. 18, figs 5 - 14; pl. 19, figs. 1, 2.

1973 Marslatourella bullata Bate; Bate, 281-284.

DIAGNOSIS. Subquadrate carapace with prominent low eye tubercles; two

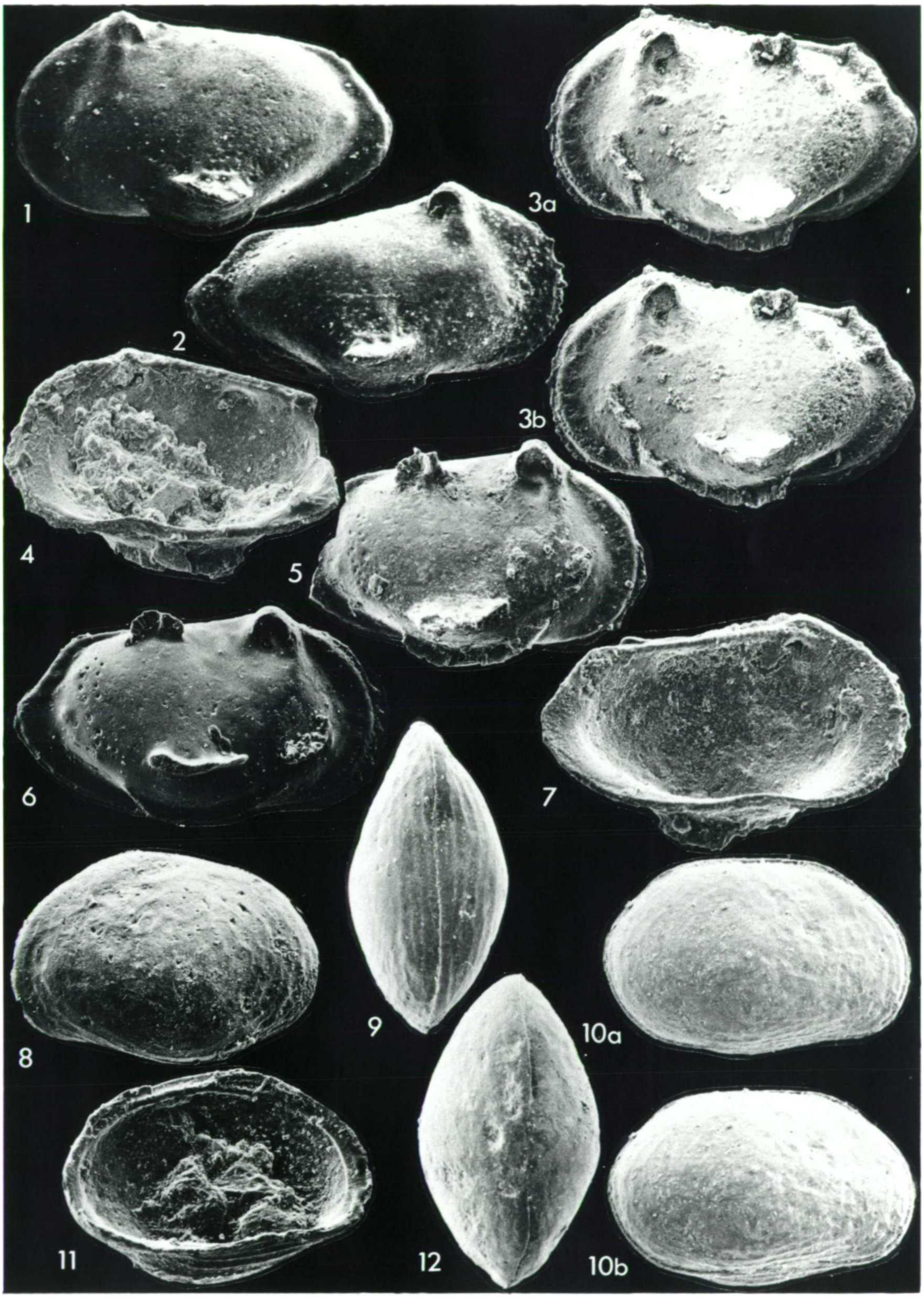
Explanation of Plate 18

Figs. 1, 2. Marslatourella bullata Bate: fig. 1, LV, OS 11797 (.68 mm long, x 88), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.8.78); fig. 2, RV, OS 11796 (.68 mm long, x 88), L. Bathonian, as above (F-PB.7.78).

Figs. 3 - 7 Marslatourella woodi sp. nov.: figs. 3, 7, holotype, LV, MPA 5567-C1 (.51 mm long, x 117): fig. 3, stereo-pair of ext. lat.; fig. 7, int. lat., U. Bathonian, U. Fuller's Earth, depth 158.50 m, Seabarn Farm borehole; figs. 4, 5, broken RV, MPA 5571-C1 (x 120): fig. 4, int. lat.; fig. 5, ext. lat., U. Bathonian, as above, depth 160.00m; fig. 6, RV, MPA 5567-C2 (.52 mm long, x 115), U. Bathonian, as above, depth 158.50 m.

Figs. 8 - 12. Konarocythere alpha gen. et sp. nov.: figs. 8, 11, ♀ LV, JM 1686-C3 (.52 mm long, x 115): fig. 8, ext. lat.; fig. 11, int. lat., U. Bathonian, Forest Marble, Bobbing borehole; fig. 9, ♀ car., vent., JM 1686-C1 (.52 mm long, x 115), U. Bathonian, as above; fig. 10, stereo-pair of holotype, ♂ car., R side, FK 105-C1 (.63 mm long, x 95), U. Bathonian, Forest Marble, Dover no. 2 borehole; fig. 12, ♀ car., dors., JM 1686-C2 (.56 mm long, x 107), U. Bathonian, Forest Marble, Bobbing borehole.

PLATE 18



short blunt ventrolateral alae developed on each valve. Shell surface punctate with dentate anterior margin.

MATERIAL. 24 valves and carapaces.

DESCRIPTION. See Bate (1967, 1973)

DISTRIBUTION. Known from the U. Estuarine Series of eastern England and the Hampen Marly Beds and White Limestone of Oxfordshire, southern central England. Herein it is further recorded from the L. Bathonian of Normandy, the U. Bathonian U. Fuller's Earth to Forest Marble (polonica to falcata Zones) of the Dorset Province and the U. Bathonian Forest Marble and equivalent beds in the Kent-Boulonnais Province.

ECOLOGY. Shallow water marine but tolerating brackish conditions, clay/ marl facies.

REMARKS. M. bullata was originally considered to be a purely marine species (Bate, 1967) but later recognised as an indicator of brackish conditions (Bate, 1973). It is here considered to be essentially marine (the L. Bathonian Normandy sequence being regarded as purely marine) but tolerating conditions of lower salinity as occur frequently in the region of the Oxfordshire Shallows to the north of the study area.

Marslatourella woodi sp. nov.

(Pl. 18, figs. 3 - 7)

DERIVATION OF NAME. In honour of my husband, Michael Wood.

DIAGNOSIS. Carapace with two curved, frill-like, ventrolateral alae, a distinct dorsomedian spine and a shallow curved frill-like ridge just behind compressed anterior margin.

MATERIAL. 6 valves

HOLOTYPE. Left valve, MPA 5567-C1, U. Bathonian, U. Fuller's Earth, depth 158.50 m, Seabarn Farm borehole, Dorset Province.

DESCRIPTION. Subquadrate carapace with large bulbous eye tubercle at anterior cardinal angle. Carapace widest and longest medially, highest in anterior third, greatest height passing through anterior cardinal angle. Anterior and posterior margins compressed. Dorsal margin straight;

posterior cardinal angle pronounced with steep posterodorsal slope; ventral margin uniformly convex with slight concavity just anterior of mid-valve length. Two frill-like alae situated ventrolaterally, anterior and posterior ends of which curve upwards. A stout ridge-like spine situated in a dorsomedian position; in well preserved specimens the anterior and posterior ends curve down. A further frill-like ridge is situated above and anterior of the lowermost ventrolateral ala, just behind anterior margin.

Shell surface punctate with a distinct double row of large sub-circular pits in posterior part of carapace, extending from just below posterior cardinal angle and curving down to just behind ventrolateral alae.

Internal details badly preserved. Inner margin and line of concrescence coincide; marginal zone of moderate width. Marginal pore canals and muscle scars not observed. Hinge apparently artioperatodont (see Bate, 1972).

Sexual dimorphism not observed.

DIMENSIONS

			L	H	Depth
holotype,	LV,	MPA 5567-C1	.51	.30	158.50 m Seabarn
paratypes:	RV,	MPA 5567-C2	.52	.29	"
	LV,	SAC 2367-C1	.51	.29	42.77-43.48 m Frome
	RV,	MPA 5571-C1	broken	.29	160.00 m Seabarn

DISTRIBUTION. This species is known only from the U. Fuller's Earth of the Seabarn Farm and Frome boreholes within the Dorset Province.

ECOLOGY. Shallow water, marine to brackish.

REMARKS. M. woodi is similar in size to the type species, M. exposita Malz but is distinguished from it by the presence of the dorsomedian spine and the anterior ridge. It similarly differs from M. bullata Bate in this respect as well as being much smaller (M. bullata has a length of .69 - .78 mm). M. dorsispinata Bate & Stephens possesses a dorsal spine although it is more blade-like than in M. woodi and the eye tubercle is characteristically stalked; also the anterior ridge seen in M. woodi is absent. A further feature which distinguishes M. woodi from all other described species of the genus is the group of surface pits in the posterior third of the carapace.

Sexual dimorphism is normally observed in *Marslatourella* with the exception of *M. dorsispinata* and the present species. Both are particularly rare elements of the U. Bathonian fauna (*M. dorsispinata* occurs to the north of the study area in Oxfordshire) and it is possible that dimorphism has simply not been recognised owing to lack of material.

Konarocythere gen. nov.

DERIVATION OF NAME. Greek, *konaros*, 'fat, well-fed', + *cythere*.
GENDER. Feminine.
DIAGNOSIS. Genus of Progonocytherinae having oval to subquadrate carapace convex dorsally with straight dorsal margin and well rounded anterior and posterior margins. Shallow, indistinct eye node. Shell surface smooth or finely reticulate.
TYPE SPECIES. *Konarocythere alpha* sp. nov.
REMARKS. This genus bears resemblances to both *Pneumatocythere* Bate, 1963 and the smaller *Micropneumatocythere* Bate, 1963. *Pneumatocythere* is distinguished by possessing a small caudal process, in having slightly compressed anterior and posterior marginal borders and in the dorsal margin tending to be convex with greater overreach of the LV over the RV in this region. *Micropneumatocythere* is distinguished from *Konarocythere*, in addition to the aforementioned features, on size, being generally smaller. *M. postrotunda* Bate 1967 should be removed from *Micropneumatocythere*, owing to its lack of a caudal process, and placed within this new genus.

Konarocythere alpha gen. et sp. nov.

(Pl. 18, figs. 8 - 12)

1978 Genus C. sp. A Bate, 238, pl. 7, figs. 10 - 12, 17.

DERIVATION OF NAME. After the original 'sp. A' notation.
DIAGNOSIS. *Konarocythere* with weak surface reticulation and several longitudinal parallel ridges along ventral surface. Sexual dimorphism

pronounced; males longer and posteriorly higher than females.

MATERIAL. 25 valves and carapaces.

HOLOTYPE. Male carapace, FK 105-C1, U. Bathonian Forest Marble, Dover no. 2 borehole, Kent Coalfield.

DESCRIPTION. Carapace oval to subquadrate with rounded anterior and posterior margins. Dorsal margin straight with rounded cardinal angles. Ventral margin slightly convex. Lines of greatest length and width pass through mid-point, greatest height through anterior cardinal angle. LV larger than RV which it overreaches uniformly all round and overlaps along posterodorsal and anterodorsal slopes. Shallow smooth, indistinct eye node at anterior cardinal angle. Shell surface smooth with a faint, even reticulation laterally and several longitudinal ridges ventrally. Ventro-lateral part of valves slightly overhangs ventral margin.

Carapace dimorphic with presumed males longer than females. Dorsal margin in females slopes to posterior cardinal angle; horizontal in males; dorsal half of male carapace thus higher than that of female.

Inner margin and line of concrescence coincide producing a narrow duplicature. Marginal pore canals straight, few in number though precise number not known. Hinge antimerodont with, in RV, 7 anterior and posterior terminal toothlets separated by a loculate median groove. Muscle scars a subvertical row of 4 oval adductors with an oval anterodorsal frontal scar.

DISTRIBUTION. Previously recorded as a species characteristic of the U. Bathonian Forest Marble of the Oxford-Bath area (Bate, 1978) and further recorded from the same level of south Dorset (Bate & Sheppard, 1981). From the study area the species is restricted to the U. Bathonian <u>falcata</u> Zone of the Forest Marble within the Dorset Province and the subsurface material of the Kent-Boulonnais Province. It is unknown from France.

DIMENSIONS.

			L	H	W	Locality
holotype,	♂ car.,	FK 105-C1,	.63	.38	.36	Dover no. 2
paratypes:	♀ car.,	JM 1686-C1,	.52	.38	.27	Bobbing
	♀ car.,	JM 1686-C2,	.56	.42	.32	"
	♀ LV,	JM 1686-C3,	.52	.38		"

		L	H	W	Locality
♂ car.,	JM 1688-C1,	.63	.44	.28	Bobbing
♀ RV,	JM 1688-C2,	.59	.37		"

All the above specimens are from the Forest Marble although precise depths are not known.

ECOLOGY. A shallow water, apparently marginal marine species, tolerating brackish and some fresh water influences.

REMARKS. This species was originally used, in association with Micropneumatocythere falcata, as an index ostracod marking the topmost Bathonian Zone 6 (Bate, 1978). The restriction of the species to beds of this age within the study area certainly supports this, although the total absence from N. France would indicate that its use is rather more local than M. falcata; indeed within the more marine horizons of the Dorset Province K. alpha is not as common a faunal element as in the more marginal beds of the Oxfordshire 'shallows' area.

Family PROTOCYTHERIDAE Ljubimova, 1955

REMARKS. This is a very important ostracod family which was established early on in the Mesozoic, in the Lower Jurassic. Originally a subfamily of the Progonocytheridae (Howe in Moore 1961) it was raised to separate family status by Bate in 1963 on the grounds that it had been wrongly assigned to the Progonocytheridae. Subsequently Kemper in 1971 regarded the Protocytheridae as a subfamily of the Trachyleberididae. Although externally certain members of the Protocytheridae, in particular the Protocytherinae, very closely resemble members of the Trachyleberididae their differences in internal features, notably the muscle scars and hinges, are here considered to merit separate familial status, in agreement with Bate and Coleman (1975).

It is feasible that the Trachyleberididae ultimately evolved from the same genetic stock as did the Protocytheridae sometime during the Bathonian when the latter was already firmly established.

Table 5 - 9 shows a range table for members of the Protocytheridae within the study area.

Subfamily PROTOCYTHERINAE Ljubimova, 1955

Genus Protocythere Triebel, 1938

REMARKS. A few species of Protocythere have been recorded from the U. Jurassic but the genus flourished in the Cretaceous where several species have been used as zonal indices. The single species of Protocythere described here represents the earliest record of the genus in the European Mesozoic. It differs slightly from the typical Cretaceous form of the genus; the dorsal and ventral ribs do not curve round so markedly which gives the characteristic bulbous appearance in the Cretaceous forms, and internally the marginal zone is not so wide; these features are considered here to represent a very primitive form.

Protocythere micropapillata sp. nov.

(Pl. 19, figs. 1 - 5)

DERIVATION OF NAME. Latin, refers to microscopic papillate ornament.
DIAGNOSIS. Subquadrate carapace with pronounced dorsal ear in left valve. Three distinct lateral ridges joined anteriorly. Shell surface covered by minute papilae; distinct collared normal pore canal openings irregularly scattered.
MATERIAL. 4 valves only.
HOLOTYPE. Left valve, BM 5514-C2, U. Bathonian, basal Cornbrash, St. Margaret's Bay borehole, Kent-Boulonnais Province.
DESCRIPTION. Subquadrate carapace with pronounced dorsal ear in left valve; straight dorsal margin, nearly straight ventral margin with some ventrolateral overhang of the valves. Greatest length of carapace passes through mid-point, greatest height through anterior cardinal angle and greatest width in posterior third. Three distinct longitudinal ridges present on lateral surface; these are open posteriorly but joined anteriorly into a large swollen area occupying anterior quarter of valve. Smooth eye tubercle present. Anterior and posterior margins compressed slightly. Posterior ridge forms posterior margin; median ridge is irregular in

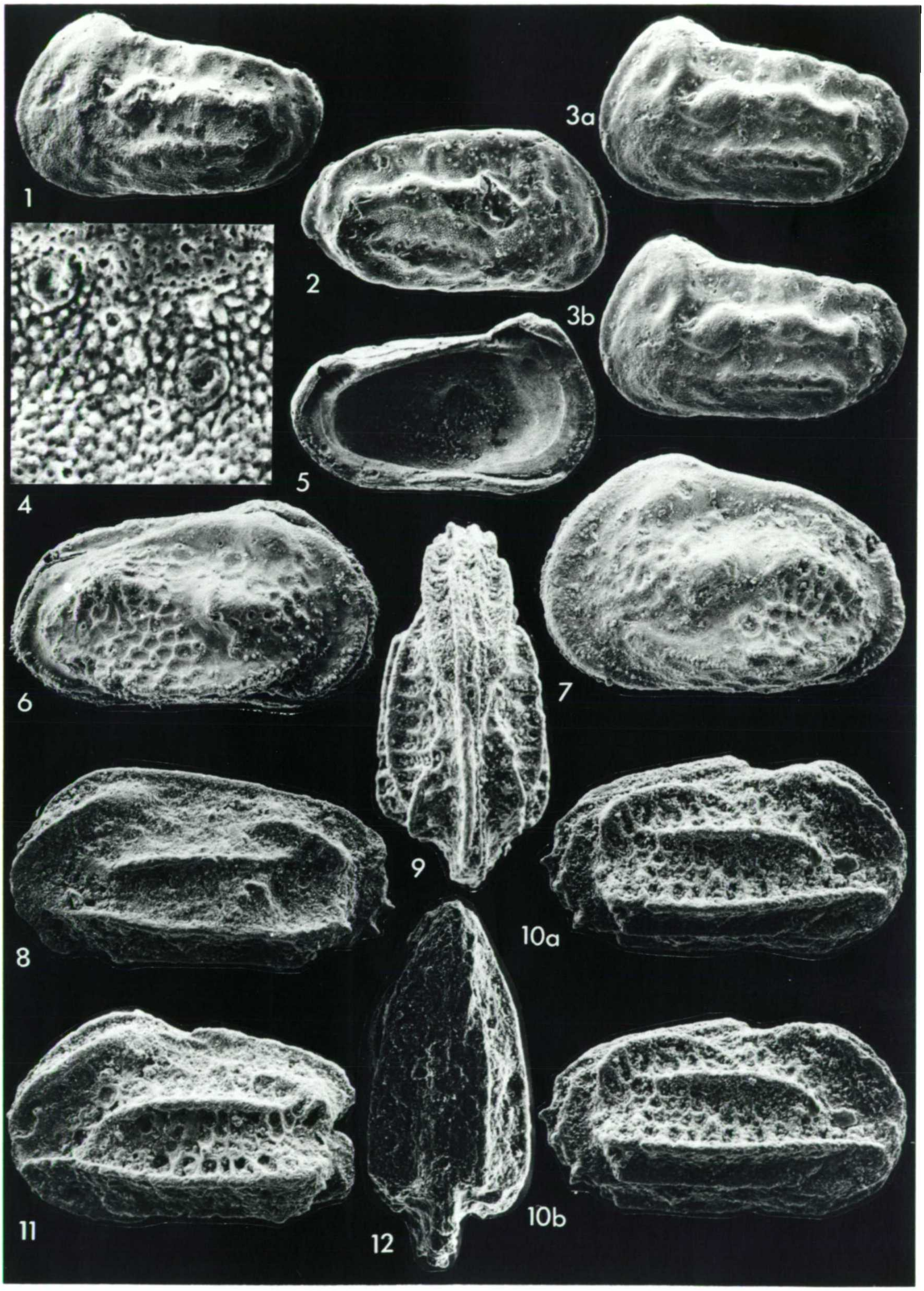
Explanation of Plate 19

Figs. 1 - 5. Protocythere micropapillata sp. nov.: fig. 1, LV, BM 5514-C3 (.50 mm long, x 100); figs. 2, 4, RV, BM 5514-C5 (.48 mm long): fig. 2, ext. lat. (x 104); fig. 4, detail of papillate ornament (x 810); figs. 3, 5, holotype, LV, BM 5514-C2 (.46 mm long, x 108): fig. 3, stereo-pair of ext. lat.; fig. 5, int. lat. All from U. Bathonian, basal Cornbrash, St. Margaret's Bay borehole.

Figs. 6, 7. Pseudoprotocythere ? bessinensis Dépêche & Oertli : fig. 6, ♂ car., R side, OS 11481 (.49 mm long, x 122), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.5.78); fig. 7, ♀ car., L side, OS 11816 (.45 mm long, x 133), L. Bathonian, as above.

Figs. 8 - 12. Pleurocythere viriosa sp. nov.: fig. 8, ♂ LV, OS 11613 (.65 mm long, x 92), U. Bathonian, Langrune Member, Lion-sur-mer (F-L.1.78); fig. 9, ♀ car., dors., OS 11614 (.53 mm long, x 113), U. Bathonian, St. Aubin Member, St. Aubin-sur-mer (F-SA.2.78); fig. 10, stereo-pair of holotype, ♀ car., R side, OS 11611 (.56 mm long, x 107), U. Bathonian, Campagnettes Member, Ranville Cement Works (F-R.4.78); fig. 11, broken ♀ LV, OS 11612 (x 108), U. Bathonian, as above; fig. 12, ♂ car., vent., OS 11615 (.63 mm long, x95), U. Bathonian, St. Aubin Member, Reviers (F-Re.7.78).

PLATE 19



width. Shell surface covered by minute papillae. Large normal pore canal openings with raised smooth collars scattered irregularly over surface.

Hinge antimerodont with approximately 5 terminal teeth anteriorly and posteriorly in RV with long median locellate groove. Muscle scars, situated within subcentral depression, comprise a vertical row of 4 rounded adductors and a U-shaped frontal scar. Inner margin and line of concrescence coincide to produce a moderately wide marginal zone with numerous pore canals which are splayed fan-like, anteriorly and, to a lesser extent, posteriorly.

Sexual dimorphism not observed.

DISTRIBUTION. Known only from the type-locality and level.

DIMENSIONS.

			L	H
holotype,	LV,	BM 5514-C2	.46	.27
paratypes:	LV,	BM 5514-C3	.50	.29
	RV,	BM 5514-C4	.46	.25
	RV,	BM 5514-C5	.48	.25

ECOLOGY. Marine, occurring within a shallow water high energy carbonate environment.

REMARKS. The papillate surface ornament of this species distinguishes it from all other species of the genus. The closest species to it stratigraphically are the U. Jurassic P. serpentina (Anderson, 1941) and P. rodewaldensis. P. serpentina, considered the senior synonym of P. sigmoidea Steghaus, 1951 by Barker (1966), differs by having the ribs arranged in a reversed 'Z'-shape with the shell surface ornamented by reticulation. P. rodewaldensis (Klinger, 1955) has a quite distinct arrangement of narrow ribs, the median and ventral ones of which are joined to form an anteroventral rib. Owing to the severe limitations stratigraphically and geographically on this species it is not possible as yet to put forward any ideas on the evolutionary or migrational patterns in relation to other, known species.

This species is placed in Protocythere rather than Mandocythere Gründel, 1964 or Pseudoprotocythere Oertli, 1966 because of its antimerodont rather than amphidont hinge.

Genus Pseudoprotocythere Oertli, 1966

Pseudoprotocythere? bessinensis Dépêche & Oertli, 1971

(Pl. 19, figs. 6, 7)

1971 Pseudoprotocythere? bessinensis Dépêche & Oertli, 49-59.

1978 Pseudoprotocythere? bessinensis Dépêche & Oertli; Bate, 246, pl. 11, fig. 8.

DIAGNOSIS. Pseudoprotocythere? with dorsal swelling extending to eye tubercle, more distinctly developed in left valve. Small tubercles present at intersection of ridges forming reticulate network. Anterior and posterior rims thickened, without reticulation but with rows of small tubercles.

MATERIAL. 41 valves and carapaces.

DESCRIPTION. Fully described by Dépêche & Oertli, 1971.

DISTRIBUTION. Originally described from the L. Bathonian of the Paris Basin this has since been further recorded from the L. Bathonian L. Fuller's Earth of the Bath District (Bate, 1978) and, more recently, from the L. Fuller's Earth of the Winterborne Kingston borehole, Dorset (Bate & Sheppard, 1981). Herein it is additionally recorded from the L. Fuller's Earth of the Seabarn Farm borehole, Dorset Province, and from the type horizon and locality, the Marnes de Port-en-Bessin at Bessin, Normandy.

ECOLOGY. Marine, occurring within clay/marl facies.

REMARKS. In the original description of this species Dépêche and Oertli stated that sexual dimorphism was not observable in their material. Examination of the present material, a large part of which was from the same locality as used by Dépêche and Oertli, has revealed that such dimorphism does, in fact, exist with males of approximately .49 mm in length and females .45 mm. Certainly females do considerably outnumber males, which probably accounts for the original description of females only.

Pseudoprotocythere is a L. Cretaceous genus, originally described from the Valanginian of Poland by Oertli, 1966. The type species P. aubersonensis Oertli, 1966 is much larger than P.? bessinensis, has the well developed dorsal ear, typical of Protocythere and differs in hinge-structure. Dépêche and Oertli regard P.? bessinensis as not strictly belonging to Pseudoprotocythere and propose to study the intermediate stages between the Bathonian and Valanginian before assigning a new generic name to it. Hence, I have retained the generic query.

P.? bessinensis is a useful stratigraphic indicator, occurring only within beds of the L. Bathonian rimosa Zone (zigzag ammonite Zone).

Genus Mandocythere Gründel, 1964

REMARKS. Mandocythere was originally erected as a subgenus of Veenia Butler & Jones but raised to generic status by Gründel, 1966. In external appearance it resembles Protocythere but differs in possessing an amphidont rather than a merodont hinge. Mandocythere differs from Veenia in possessing loculate terminal hinge sockets in the left valve rather than smooth as in the latter genus. The present species represents the earliest recorded member of the genus.

Mandocythere primaeva sp. nov.
(Pl. 21, figs. 5 - 11)

DERIVATION OF NAME. Latin primaevus, meaning early.
DIAGNOSIS. Small species of Mandocythere (length .45 mm) with three simple, discrete lateral ridges and compressed anterior and posterior margins. Shell surface smooth.
MATERIAL. 14 valves and carapaces.
HOLOTYPE. Left valve, MPA 2072-C1, M. Bathonian Fuller's Earth Rock (confossa Zone), depth 809.00 - 809.15 m, Winterborne Kingston borehole, Dorset Province.
DESCRIPTION. Subquadrate carapace, longest medially, widest posteriorly and highest anteriorly corresponding with prominent anterodorsal 'ear' of both valves. Anterior margin broadly rounded and compressed; posterior margin truncate and compressed. Carapace inflated in dorsal view with maximum inflation ventrolaterally where valves slightly overhang ventral

margin. Shell surface with 3 pronounced longitudinal lateral ridges separated by 2 deep grooves. In LV dorsal ridge forms dorsal outline, projecting a good distance above hinge line. Median ridge interrupted medially by shallow muscle scar depression. Dorsal ridge in both valves expanded anteriorly into large eye tubercle. Shell surface smooth. LV larger than RV which it overreaches anteriorly, especially anterodorsally, and posteriorly.

Muscle scars comprise a curved row of 4 oval adductors, a large crescentric frontal scar and a small rounded anteroventral scar. Hinge amphidont with, in LV, deep loculate sockets separated by a smooth median bar, expanded anteriorly into a divided tooth. RV with corresponding terminal dentate ridges separated by a smooth groove with loculate socket anteriorly. Inner margin and line of concrescence coincident; marginal zone wide especially at anterior; pore canals long, numerous, slightly splayed fan-like.

DISTRIBUTION. Known from the M. Bathonian Fuller's Earth Rock of the type locality and also from the U. Bathonian Campagnettes Member (blakeana Zone) and St. Aubin Member (falcata Zone) from the Calvados region of Normandy.

DIMENSIONS.

			L	H	W	Locality
						Winterborne Kingston
holotype,	LV,	MPA 2072-C1	.45	.28		809.00 - 809.15 m
paratypes:	RV,	MPA 2072-C2	.45	.24		" "
	LV,	MPA 2074-C1	.48	.26		809.34 - 810.05 m
	RV,	MPA 2074-C2	.43	.23		" "
	car.,	OS 11846	.47	.28	.25	F-R.16A.78
	car.,	OS 11847	.50	.28	.25	"
	car.,	OS 11848	.43	.25	.21	F-Re.14.78
	car.,	OS 11849	.51	.29	.23	F-R.16.78

ECOLOGY. Shallow water, near shore species.

REMARKS. In external appearance this species closely resembles the early Protocythere, P. micropapillata sp. nov. and is distinguished from it by having a more compressed anterior margin and lacking the delicate microscopic papillate ornament of the latter species. Internally the two are quite distinct, P. micropapillata possessing an antimerodont rather than amphidont hinge and a relatively narrow duplicature. Protocythere (Costacythere) juettneri Pokorny, 1973 from the presumed Tithonian of Czechoslavakia differs from the present species by having a distinct surface reticulation and much shorter median ridge. Otherwise, it is externally very close; internally the distinction again is based on the type of hinge. Taxonomically, Pokorny's species was placed in Costacythere Gründel, 1966 because of the absence of an anterior tooth on the median hinge bar in the left valve. It lacks, however, the anteromarginal rim of Gründel's original diagnosis, although he regards this feature as of insignificant importance in the evolution of the Protocytheridae. Gründel made Costacythere a subgenus of Mandocythere; M. primaeva cannot, on the basis of hinge, be assigned to Costacythere; indeed, Pokorny's assignment of Costacythere to Protocythere because of its merodont hinge would appear to be the more acceptable.

Subfamily PLEUROCYTHERINAE Mandelstam, 1960

REMARKS. This subfamily, introduced by Mandestam (1960) was included by Howe (in Moore, 1961, Q.327) in the subfamily Protocytherinae Ljubimova (1955) of the family Progonocytheridae, but reinstated as a distinct subfamily unit of the same family by Bate (1963). Whatley (1970) regards this as a subfamily of the family Protocytheridae; in this thesis Pleurocythere is considered to have greater affinities to Protocythere and the Protocytheridae than to Progonocythere and the Progonocytheridae; Whatley's classification is consequently adopted here.

Genus Pleurocythere Triebel, 1951

DIAGNOSIS (emended). Carapace elongate with three distinct longitudinal lateral ridges and a short anterodorsal ridge. Valve surface smooth or reticulate. Left valve larger than right. Hinge antimerodont. Inner margin and line of concrescence coincide; marginal zone wide anteriorly;

marginal pore canals curved. Muscle scars a subvertical row of four adductors with a kidney-shaped anterodorsal frontal scar and an oval anteroventral mandibular scar.

TYPE SPECIES. Pleurocythere richteri Triebel, 1951.

REMARKS. When Triebel erected the genus in 1951 he assigned 6 species to it and devised a simple key for the identification of each one based on length of ridges, whether or not they are joined together, whether or not the valve surface is reticulate etc. Several species have since been assigned to the genus which fit in with this scheme, except perhaps those Scottish Callovian species erected by Whatley (1970) which possess a larger number of lateral ridges than the diagnostic 3.

Pleurocythere closely resembles Palaeocytheridea Mandelstam, 1947 in external characteristics, both being similar in shape and possessing longitudinal lateral ridges, which would account for Whatley (1970) placing them both in the same subfamily. Pleurocythere is distinctively laterally compressed anteriorly, just behind the anterior margin beneath the anterodorsal ridge; it is more inflated in dorsal view with the greatest width in the posterior portion; there are always 3 lateral surface ridges plus a ventral ridge. In Palaeocytheridea there are 2 lateral ridges extending almost the entire length of each valve which tend to be straight sided in dorsal view. Internally Pleurocythere has wide marginal zones with numerous long, curved pore canals while Palaeocytheridea has marginal zones of moderate width with fewer short, straight pore canals.

Pleurocythere is not a common genus within the study area, as the numbers of individuals for each species demonstrate. Of all the previously described species only one, P. favosa Triebel, 1951 has been found. Two species are described as new and one is left under open nomenclature owing to lack of material.

It is interesting to theorise on the possible phylogeny of the genus (see Table 5-10, Callovian species are not included). There appears to be no noticeable reduction or enlargement in the length of the ridges through time, or a trend towards the ridges becoming either connected or widely separated. There is thus no single evolutionary trend observable for these species.

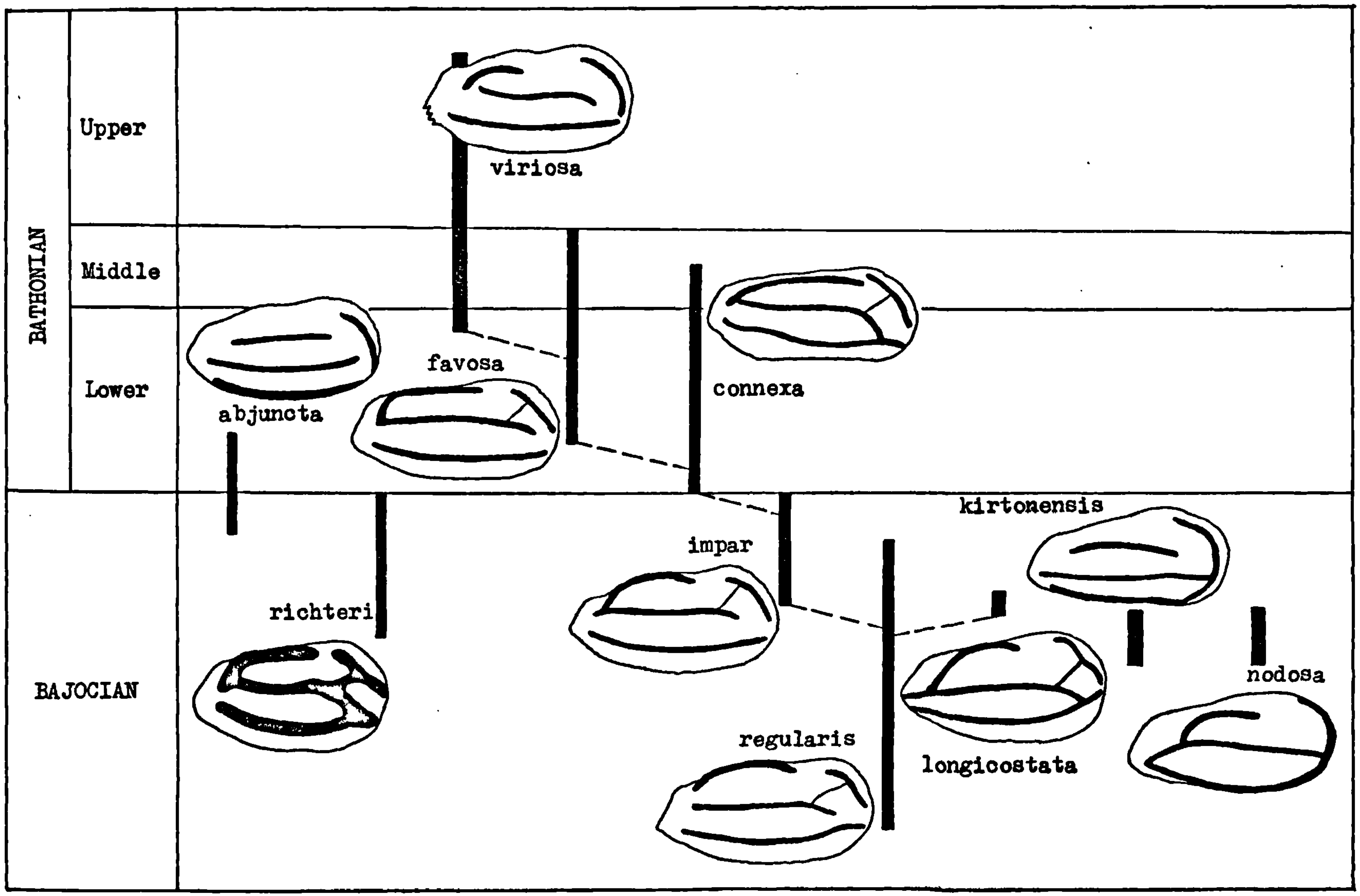


Table 5-10 Phylogenetic relationships of species of Pleurocythere.

Pleurocythere viriosa sp. nov.

(Pl. 19, figs. 8 - 12)

1973 Pleurocythere sp. Dépêche, pl. 1, figs. 1, 2.

DERIVATION OF NAME. Latin, meaning robust, strong.

HOLOTYPE. Female carapace, OS 11611, Campagnettes Member limestones, U. Bathonian, Ranville, Normandy.

DIAGNOSIS. Pleurocythere with short median lateral ridge, sloping upwards posteriorly, long lowermost lateral ridge paralleling ventral ridge which forms ventral border, and curved short unattached posterodorsal ridge. A further anterodorsal ridge is situated close to anterior margin. Several short spines are present along posteroventral part of posterior margin. Valve surface reticulate.

MATERIAL. 18 valves and carapaces.

DESCRIPTION. Elongate-oval carapace with greatest height passing through anterior cardinal angle, greatest length medially and greatest width formed by posterior portion of lowermost lateral ridge. Anterior margin rounded, posterior margin acuminate, laterally compressed, with several short spines on posteroventral corner. Dorsal and ventral margins straight; cardinal angles pronounced. Surface ornamentation well developed with high-walled ridges, arrangement as for diagnosis. Smooth eye node situated just below anterior cardinal angle, at posterior end of anterodorsal ridge. LV larger than RV which it overlaps strongly along dorsal margin and overreaches along ventral margin.

Hinge merodont, although preservation is too poor to determine which type and the precise number of terminal teeth. Inner margin and line of concrescence coincident with wide marginal zone; marginal pore canals long, numerous and slightly curved. A well developed flange is present outside selvage, particularly around anterior margin.

DIMENSIONS.

		L	H	W	Locality
holotype, ♀ car.,	OS 11611	.56	.30	.26	F-R.4.78
paratypes: ♀ LV,	OS 11612	broken	.32		F-R.4.78
♂ LV,	OS 11613	.65	.34		F-L.1.78

		L	H	W	Locality
♀ car.,	OS 11614	.53	.30	.27	F-SA.2.78
♂ car.,	OS 11615	.63	.34	.29	F-Re.7.78
♀ LV,	OS 11616	.56	.30		F-Re.7.78

DISTRIBUTION. P. viriosa is here recorded from the L. Bathonian of Port-en-Bessin and from several horizons within the U. Bathonian at 4 localities in the Normandy Province (Ranville, Reviers, Lion-sur-mer and St. Aubin-sur mer). It is unknown from southern England and Boulonnais.

ECOLOGY. Shallow water marine, preferring a carbonate facies; inhabits relatively high energy environments.

REMARKS. The sculpturing on P. viriosa is particularly intense for species of Pleurocythere and well suits it for a high energy habitat. The spinose posterior margin is only seen in one other species of the genus, P. nodosa Bate from the Bajocian of the English midlands, which has dentate anterior and posterior margins.

Of the described species of Pleurocythere, P. viriosa most closely resembles P. favosa Triebel, 1957 but is distinguished from it by having a shorter median ridge with no short anterior connecting rib to the anterodorsal ridge, by having a shorter, more curved posterodorsal ridge unconnected to the median ridge and in the possession of marginal spines. The sculpturing in P. viriosa is also much more intense than in P. favosa. It would seem likely that P. favosa was ancestral to P. viriosa.

Pleurocythere abjuncta sp. nov.

(Pl. 20, figs. 1 - 4)

1981 Palaeocytheridea parabakirovi of Dépêche; Bate & Sheppard, in press.

DERIVATION OF NAME. Latin, meaning disunited, separated, referring to nature of lateral ridges.

DIAGNOSIS. Pleurocythere with three unconnected horizontal, parallel lateral ridges, lowermost of which forms ventral border with a ventral ridge below this. An anterodorsal ridge runs from mid-anterior margin up to smooth eye node. Valve surface reticulate apart from smooth posterior margin.

Explanation of Plate 20

Figs. 1 - 4. Pleurocythere abjuncta sp. nov.: fig. 1, ♀ LV, MPK 2528 (.60 mm long, x 100), U. Bajocian, Inferior Oolite, depth 910.08 - 910.21 m, Winterborne Kingston borehole; figs. 2, 3, 4, holotype, OS 11617 (.60 mm long, x 100): fig. 2, dors.; fig. 3, stereo-pair of L side; fig. 4, R side, L. Bathonian, Passage Beds, Port-en-Bessin (F-PB.1.79).

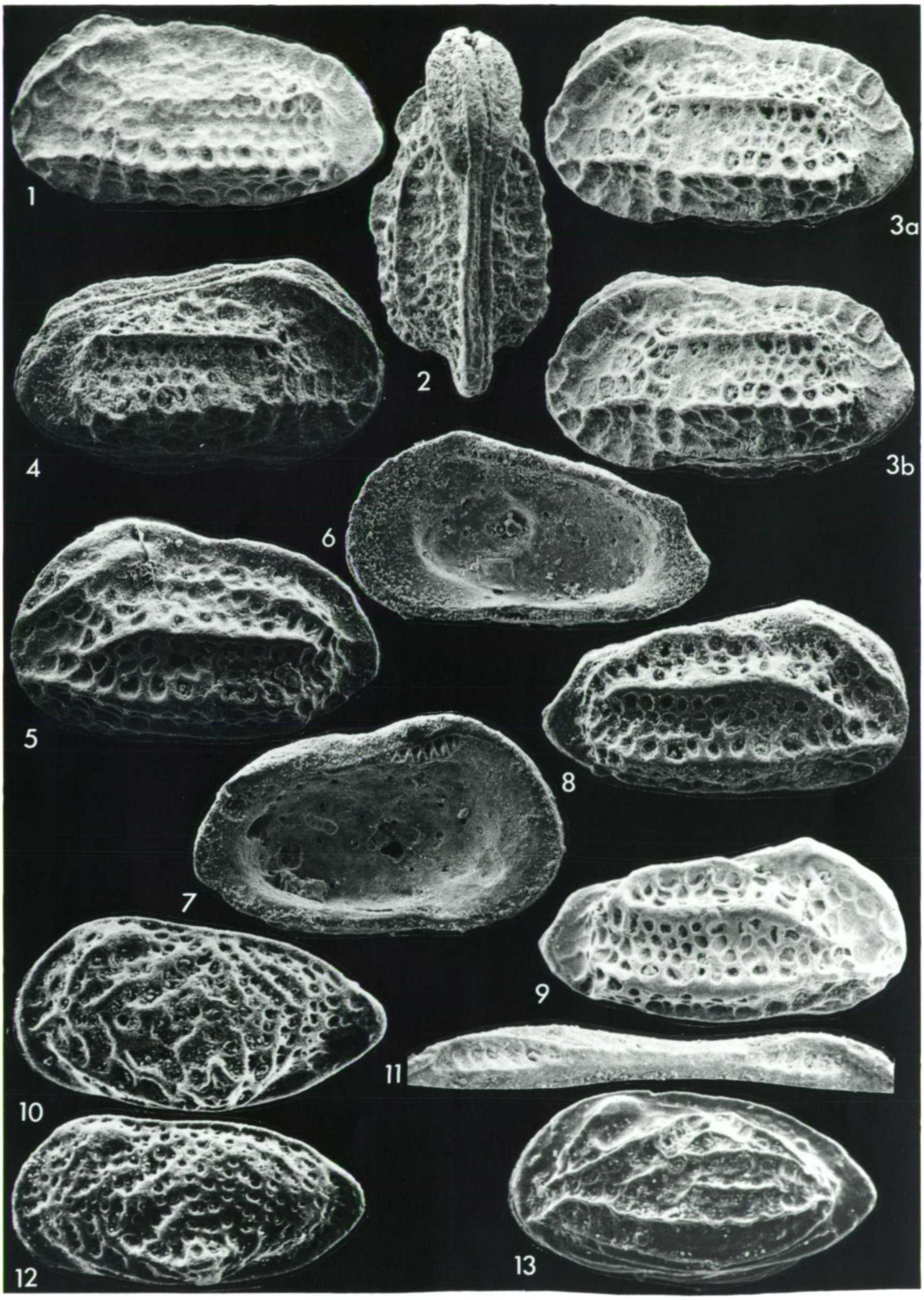
Figs. 5 - 8. Pleurocythere favosa Triebel: figs. 5, 7, ♀ LV., MPA 2074-C3 (.59 mm long, x 101): fig. 5, ext. lat.; fig. 7, int. lat., M. Bathonian, Fuller's Earth Rock, depth 809.34 - 810.05 m, Winterborne Kingston borehole; figs. 6, 8, ♂ RV, MPA 2074-C4 (.57 mm long, x 105): fig. 6, int. lat.; fig. 8, ext. lat., M. Bathonian, as above.

Fig. 9. Pleurocythere sp. cf. P. favosa Triebel, ♂ RV, MPK 2526 (.58 mm long, x 103), M. Bathonian, Fuller's Earth Rock, depth 809.34 - 810.05 m, Winterborne Kingston borehole.

Figs. 10 - 12. Kinkelinella malzi (Dépêche): fig. 10, ♀ LV, OS 11483 (.53 mm long, x 113), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F.PB.10.78); fig. 11, ♀ LV, int., hinge, OS 11812 (x 400), L. Bathonian, as above, fig. 12, ♂ LV, OS 11811 (.52 mm long, x 115), L. Bathonian, as above (F-PB.7.78).

Fig. 13. Ektyphocythere parva (Oertli), car., L side, OS 11817 (.45 mm long, x 133), L. Bathonian, as above (F-PB.40.78).

PLATE 20



MATERIAL. 3 carapaces, 1 valve.

HOLOTYPE. Female carapace, OS 11617, Passage Beds, L. Bathonian, Port-en-Bessin, Normandy.

DESCRIPTION. Subquadrate carapace with greatest length just below mid-point, greatest height passing through anterior cardinal angle and greatest width in posterior quarter, immediately in front of compressed posterior margin. Surface ornamentation as for diagnosis. Anterior margin rounded, posterior margin triangular and rounded with steep posterodorsal slope. Cardinal angles pronounced. LV larger than RV which it overlaps strongly along dorsal margin and overreaches slightly along ventral margin.

Internal details not observed.

DISTRIBUTION. P. abjuncta is recorded from lowermost Bathonian sediments of Normandy (herein) and uppermost Bajocian sediments from the Dorset Province (previously identified as Palaeocytheridea parabakirovi).

DIMENSIONS.

		L	H	W	Locality
holotype, ♀ car.,	OS 11617	.60	.33	.28	F-PB.1.79
paratypes: ♀ LV	MPK 2528	.60	.34		Winterborn Kingston 910.08 - 910.21 m
♀ car.,	MPA 2201-C1	.62	.36	.28	910.83 - 911.08 m

ECOLOGY. Shallow water marine, clay facies.

REMARKS. The arrangement of surface ridges on P. abjuncta differs from all other species of the genus in that there is no posterodorsal ridge curving down posteriorly (which is particularly noticeable in right valves). Instead, there is a third ridge forming the ventral border which makes up the compliment of 3 lateral ridges, diagnostic of the genus. A somewhat similar situation is seen in P. kirtonensis Bate, 1963 where the lowermost ridge forms the ventral border but the uppermost one does curve down posteriorly although it is not situated along the dorsal margin as in the type-species P. richteri Triebel, 1957.

P. abjuncta is here assigned to Pleurocythere rather than to Palaeocytheridea because of the characteristic shape in dorsal view, the compressed nature of the anterior marginal area below the anterodorsal ridge and the possession of 3 rather than 2 lateral ridges, which all differ in length.

Pleurocythere favosa Triebel, 1951

(Pl. 20, figs. 5 - 8)

1951 Pleurocythere favosa Triebel, 93, pl. 46, figs. 19 - 22.

1979 Pleurocythere favosa Triebel; Bate, fig. 5.

DIAGNOSIS. Subquadrate carapace with posterodorsal ridge extending forwards to beyond mid-point of dorsal margin; long median ridge posteriorly attached to posterodorsal ridge and anteriorly attached by a short connecting rib to anterodorsal ridge; long ventrolateral ridge. Reticulate shell surface.

MATERIAL. 5 valves.

DESCRIPTION. See Triebel, 1951.

DISTRIBUTION. A L. Bathonian species described originally from Germany but subsequently recorded in the Bath area of southern England (L. Fuller's Earth) by Bate (1979). It is here recorded from the top of the Fuller's Earth Rock equivalent in the Winterborne Kingston borehole, Dorset Province only.

ECOLOGY. Marine, shallow water.

REMARKS. This represents the youngest record of the species, having previously been known only from the Lower Bathonian. P. favosa is the only one of Triebel's original 6 species of the genus to be recorded from England. It would seem likely that P. favosa developed from the basal Bathonian P. connexa Triebel, 1951 by way of a simple reduction in length of the posterodorsal ridge and an anterior disconnection of the median and ventrolateral ridges.

Pleurocythere sp. cf. P. favosa Triebel, 1951

(Pl. 20, fig. 9)

1981 Pleurocythere cf. favosa Triebel; Bate & Sheppard, in press.

REMARKS. A single specimen of a species of Pleurocythere was found at the top of the Fuller's Earth Rock in the Winterborne Kingston borehole, Dorset Province, which resembles P. favosa in every respect except that there is no short connecting rib between the anterior part of the median ridge and the anterodorsal ridge. On the strength of one specimen it is difficult to say with certainty that this is a new species, although the stratigraphic position would support this; the specimen being found at a higher level than that of P. favosa.

Subfamily KIRTONELLINAE Bate, 1963

REMARKS. Genera belonging to this subfamily are characterised by having simple, straight marginal pore canals.

Genus Kinkelinella Martin, 1960

DIAGNOSIS. Carapace subtrigonal to subquadrate with compressed marginal borders. Central part of carapace strongly convex, overhanging ventral surface. Shell surface ornamented by ribbing which forms a coarse reticulation or has dorso-ventral elements dominant.
TYPE SPECIES. Kinkelinella tenuicostata Martin, 1960.
REMARKS. Kinkelinella was originally diagnosed as possessing a hemimerodont hinge, hence Ektyphocythere Bate, 1963 was established for species having a triangular ornamentation and an antimerodont hinge. Malz, however, in 1966 effectively brought the two into synonymy when he reported that the hinge of Kinkelinella was in fact antimerodont, and included within it Procytheridea triangula Brand, 1961 which had previously been made the type-species of Ektyphocythere. Kinkelinella was considered a genus distinct from Procytheridea Peterson, 1954 and known from the Toarcian, Aalenian and Bajocian of Europe (Malz, 1966). It is distinguished particularly by its almost alate ventrolateral extensions and well developed anterior and posterior marginal rims. These two features plus the strong reticulate ornament are totally lacking in P. exampla Peterson, 1954, the type-species of Procytheridea.

Kinkelinella and Ektyphocythere represent two morphological groups with strikingly different ornamental patterns which Bate and Coleman (1975) consider are congeneric but that each group is developed to such an extent that a subgeneric category is required for each one. I would go one step further and suggest that the differences in ornamentation (or more correctly in sculpture when dealing with a higher order of importance than purely specific) are sufficient to distinguish the two as separate genera rather than subgenera of Kinkelinella, indeed as Lord has done (1978).

The single species of Kinkelinella described here, K. malzi (Dépêche, 1973) represents the youngest record of the genus and most advanced in terms of wing formation.

Kinkelinella malzi (Dépêche, 1973)

(Pl. 20, figs. 10 - 12)

1973 Glyptocythere? malzi Dépêche, 222, pl. 2, figs. 9 - 13.

1979 Glyptocythere? malzi Dépêche; Bate, fig. 5.

DIAGNOSIS (emended). Species of Kinkelinella with alate ventrolateral extension of valves and coarse reticulate ornamentation produced by dorso-ventral trending ridges and grooves. Shallow subcentral sulcus situated in front of ala. Smooth eye node.

MATERIAL. 55 valves and carapaces.

DESCRIPTION. See Dépêche, 1973.

DISTRIBUTION. Recorded by Dépêche from the L. Bathonian Marnes de Port-en-Bessin and from the L. Bathonian L. Fuller's Earth of the Dorset Province (batei Subzone of the rimosa Zone in both instances).

ECOLOGY. Marine, the alate extensions of the valves implying a fine-grained muddy sea-bottom type of environment.

REMARKS. Although the muscle scars have not been observed in this species it is here assigned to Kinkelinella on the strength of the ventro-lateral overhang of the valves, the compressed anterior and posterior marginal borders, the simple, straight marginal pore canals, the hinge and presence of an eye node. The alate extensions of the valves are more pronounced than in any other species of the genus and associated with these are subcentral sulci which are not seen in other species. This is, however, the youngest recorded species of the genus; the well developed alae may simply be morphological adaptations which evolved as a result of inhabiting a marine environment with a muddy sea-floor in which it was advantageous to increase the surface area/volume ratio of the carapace to prevent sinking. Such an environment was common in the Lower Jurassic (Lord, 1972) and also in the lowermost Bathonian.

Genus Ektyphocythere Bate, 1963

Ektyphocythere parva (Oertli, 1960)

(Pl. 20, fig. 13)

1959 Procytheridea minuta Oertli, 122, pl. 3, figs. 37 - 40.

1960 Procytheridea parva Oertli, 70

1969 Ektyphocythere parva (Oertli); Bate, 430, pl. 14, figs. 1, 3.

1978 Kinkelinella (Ektyphocythere) parva (Oertli); Bate, 240, pl. 8, figs. 9, 10.

DIAGNOSIS. Small species of Ektyphocythere with triangular pattern of ridges disrupted medially by oblique median depression. Small anterodorsal ridge to smooth eye node.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Oertli, 1959.

DISTRIBUTION. E. parva ranges throughout the Bathonian. Originally described as part of the micro-ostracod fauna of the U. Bathonian of Boulonnais it has since been recorded from L. to U. Bathonian sediments of the Bath district of southern England. It is here further recorded from "Les Pichottes" Quarry, Boulogne, from the Forest Marble and Cornbrash of the Kent Coalfield boreholes, the L. to U. Bathonian of Normandy (rimosa to falcata Zones) and L. to U. Bathonian (L. Fuller's Earth to L. Cornbrash) within several borehole sections of the Dorset Province.

ECOLOGY. A marine species occurring in a wide range of lithologies indicating tolerance of a sand, clay and carbonate environment.

REMARKS. This is a relatively common Bathonian ostracod, of little use stratigraphically because of its long range and is the youngest known species of the genus.

Genus Looneyella Peck, 1951

REMARKS. Looneyella was originally included within the subfamily Protocytherinae in the family Progonocytheridae by Howe in Moore, 1961 (before the Protocytherinae was raised to family status by Bate in 1963). In 1969 Bate included it within the family Cytherirdae but Whatley (1970, p. 349) considers that, on the grounds of shape, ornament, hinge and musculature, it belongs in the subfamily Kirtonellinae of the Protocytheridae. This is accepted here.

Looneyella subtilis Oertli, 1959
(Pl. 21, figs. 1 - 4)

1959 Looneyella? subtilis Oertli, 119, pl. 3, figs. 31 - 35.
1969 Looneyella subtilis Oertli; Bate, 431, pl. 14, figs. 7, 8.

DIAGNOSIS (emended). Small species of Looneyella with prominent posterodorsal tubercle and smaller anteromedian tubercle. A marginal ridge extends around anterior margin and along ventrolateral alar extention. Tubercles and ridge are hollow. A further small tubercle often present below posterodorsal tubercle. Shell surface finely reticulate. Hinge antimerodont. Dimorphic.
MATERIAL. 35 valves.
DESCRIPTION. See Oertli, 1959.
DISTRIBUTION. An U. Bathonian species, originally described by Oertli from the Forest Marble equivalent (discus ammonite Zone) in Boulogne, and later by Bate from the Bradford Clay (top of aspidoides ammonite Zone) of Bradford-on-Avon, Somerset. Herein it occurs in the Forest Marble of the Dorset Province and in the Forest Marble of the subsurface material in the Kent-Boulonnais Province as well as the equivalent beds in Boulogne.

Explanation of Plate 21

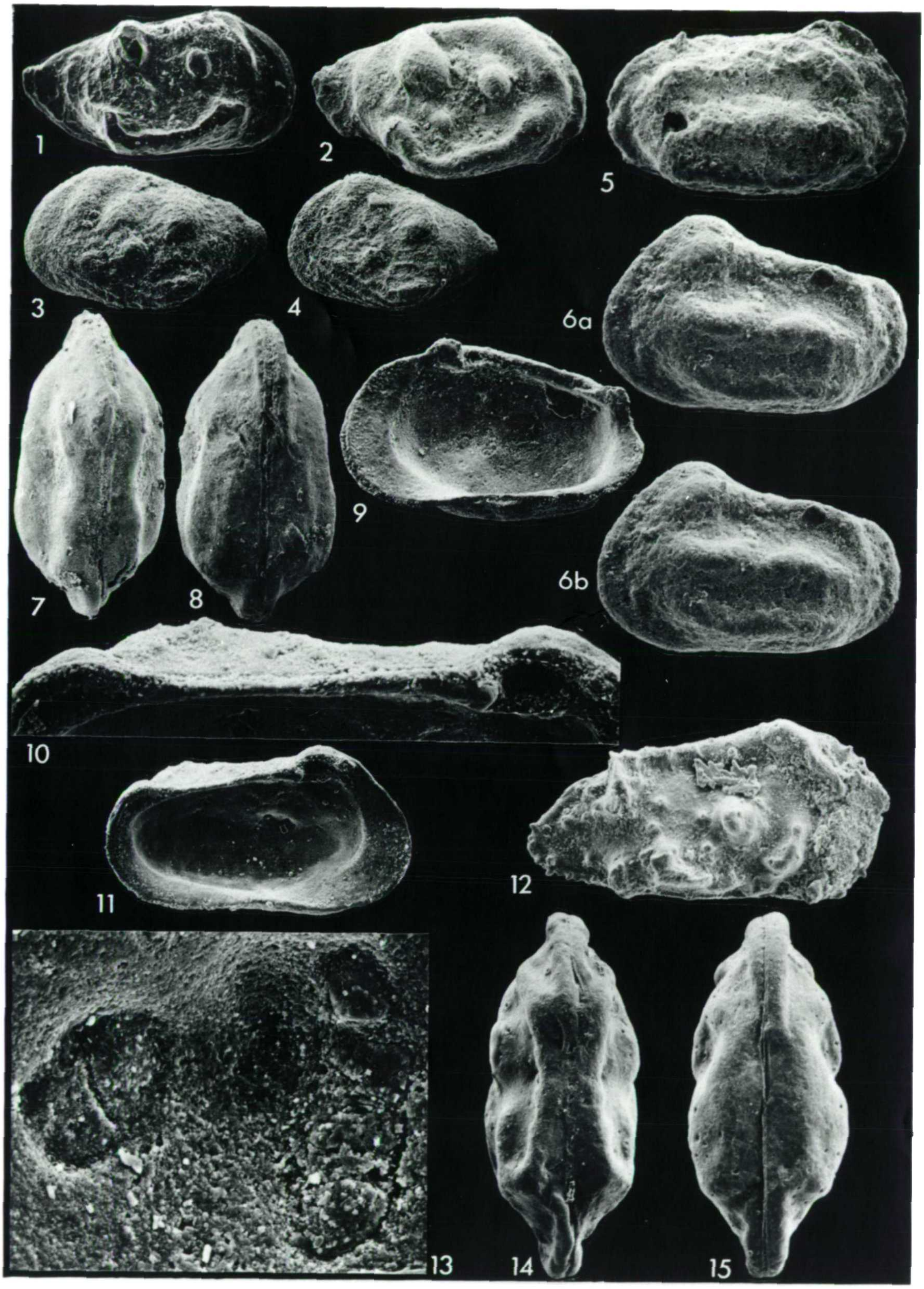
Figs. 1 - 4. Looneyella subtilis Oertli: fig. 1, ♂ RV, specimen now broken (.38 mm long, x 118), U. Bathonian, Forest Marble, Bobbing borehole; fig. 2, ♀ RV, OS 11818 (.37 mm long, x 121), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.3.79); fig. 3, juv. LV, OS 11820 (.31 mm long, x 129), U. Bathonian, as above; fig. 4, juv. LV, OS 11819 (.23 mm long, x 152), U. Bathonian, as above.

Figs. 5 -11. Mandocythere primaeva sp. nov.: figs. 5, 7, car., OS 11847 (.50 mm long, x 100): fig. 5, R side; fig. 7, dors., U. Bathonian, Campagnettes Member, Carrière des Campagnettes, Ranville (F-R.16A.78); fig. 6, stereo-pair of holotype, LV, MPA 2072-C1 (.45 mm long, x 111), M. Bathonian, Fuller's Earth Rock, depth 809.00 - 809.15 m, Winterborne Kingston borehole; fig. 8, car., vent., OS 11846 (.47 mm long, x 106), U. Bathonian, Campagnettes Member (F-R.16A.78); fig. 9, RV int., MPA 2072-C2 (.45 mm long, x 111), M. Bathonian, Fuller's Earth Rock, as above; figs. 10, 11, LV, MPA 2074-C1 (.48 mm long); fig. 10, hinge (x 190); fig. 11, int. lat. (x 104), M. Bathonian, as above, depth 809.34 - 810.05 m.

Fig. 12. Oligocythereis fullonica (Jones & Sherborn), RV, MPA 5000-C1 (.47 mm long, x 127), U. Bathonian, Forest Marble, depth 74.48 m, Seabarn Farm borehole.

Figs. 13 - 15. Oligocythereis ranvillensis sp. nov.: fig. 13, muscle scars of RV int., OS 11825 (x 800), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.3.79); fig. 14, car., dors, OS 11822 (.55 mm long, x 109), U. Bathonian, Campagnettes Member, Ranville Cement Works (F-R.3A.78); fig. 15, holotype, car., vent., OS 11821 (.53 mm long, x 113), U. Bathonian, as above.

PLATE 21



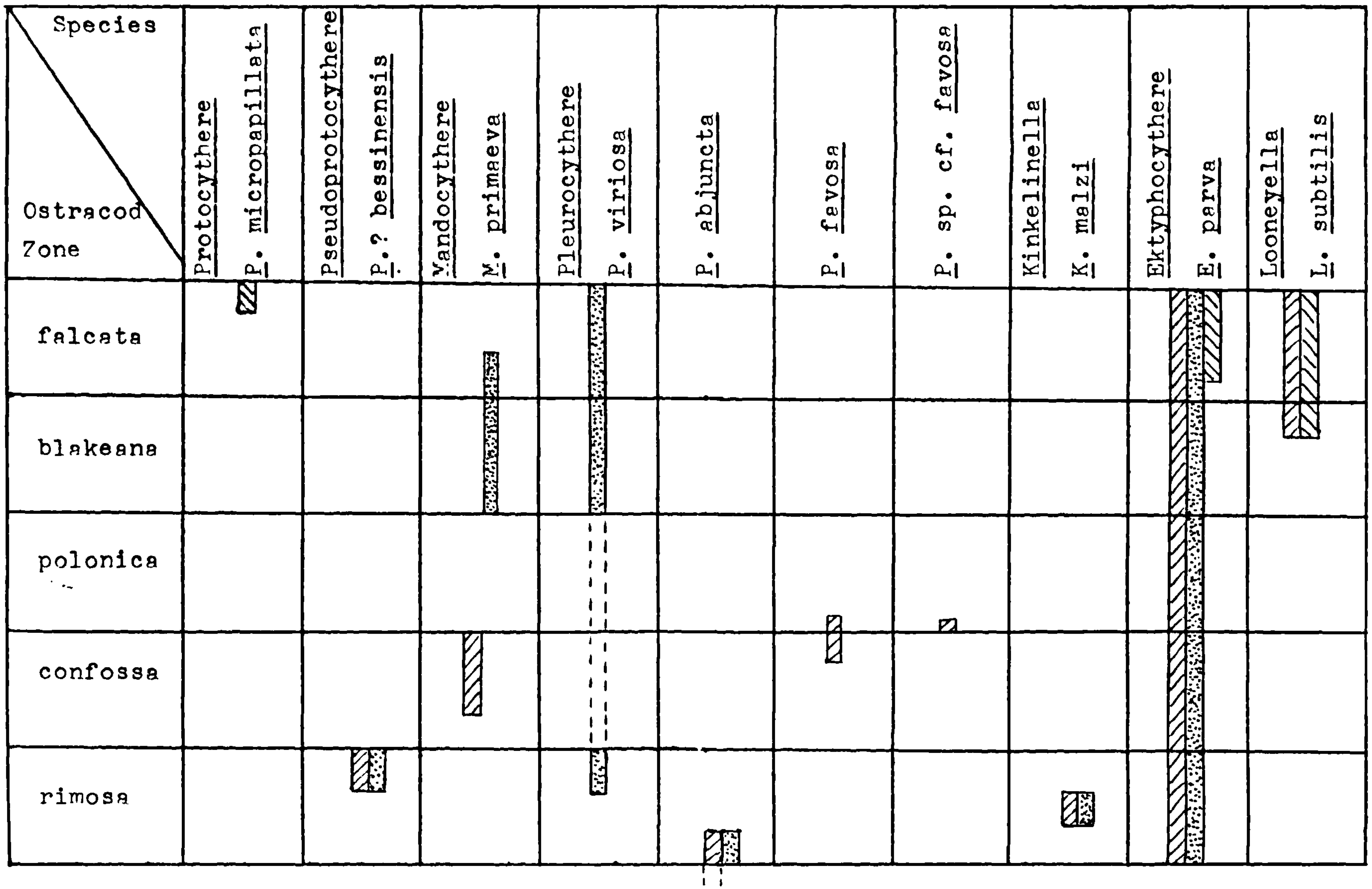


Table 5-9 Range table for members of the Protocytheridae.

The species is restricted to beds of blakeana and falcata ostracod Zones. It has not been found in Normandy.

ECOLOGY. This species is marine, as opposed to the type-species of the genus, C. monticula (Jones, 1893) which occurs in non-marine Cretaceous sediments.

REMARKS. The diagnosis is here slightly emended to include a reticulate shell surface, previously thought to have been smooth, which is only observable in scanning electron micrographs.

It is interesting to observe the ontogenetic development of this species. In the adult form it is the posterodorsal tubercle which is the larger of the two tubercles. In juvenile forms, however, it is the anteromedian tubercle which is the most prominent with the third tubercle (often missing in adults) obvious and the posterodorsal one barely recognisable. Surface reticulation is present in the juvenile forms. The prominence of the posterodorsal tubercle and of the marginal ridge occurs only with the final moult.

The restriction of L. subtilis to beds of blakeana or falcata ostracod Zone age enable it to be a zonally important species.

Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948

Genus Oligocythereis Sylvester-Bradley, 1948

Oligocythereis fullonica (Jones & Sherborn, 1888)

(Pl. 21, fig. 12)

1888 Cythereis fullonica Jones & Sherborn, 256, pl. 4, figs. 13a - c.

1948 Cythereis cf. fullonica Jones & Sherborn; Sylvester-Bradley, 186, pl. 12, figs. 7, 8 (not figs. 9, 10); pl. 13, fig. 3 (not fig. 9)

1969 Oligocythereis fullonica (Jones & Sherborn); Bate, 240, pl. 8, figs. 12, 13.

DIAGNOSIS. Prominent eye tubercle with short anterodorsal ridge projecting from it; dorsomedian ridge joined to eye tubercle anteriorly, posteriorly enlarged to form blade-like projection. Prominent subcentral tubercle; short ventrolateral ridge; anteroventral and posteroventral tubercles. Valve margins spinose.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Bate, 1969.

DISTRIBUTION. This is a long ranging Bathonian species, originally described from the U. Bathonian Blue Fuller's Earth Clay, near Bath, Somerset; later by Sylvester-Bradley from the U. Bathonian boueti Bed of Langton Herring, Dorset, and subsequently from L. to U. Bathonian sediments (rimosa to falcata Zones) from several localities in the Bath district (Bate, 1978) and in Dorset (Bate & Sheppard, 1981). To the north of the present study area Ware and Whatley (1980) have recorded it from the U. Bathonian (falcata Zone) of Kirtlington, Oxfordshire.

REMARKS. O. fullonica sensu stricto is restricted to forms having the posterodorsal projection as illustrated, with two short arms at right angles, and with the muscle scar node completely isolated and not joined to the anterior termination of the ventrolateral ridge. Forms not complying with these morphological restrictions should be assigned to different species.

Oligocythereis ranvillensis sp. nov.

(Pl. 21, figs. 13 - 15; pl. 22, figs. 1-5)

1948 Cythereis cf. fullonica Jones & Sherborn; Sylvester-Bradley, pl. 12, fig. 10.

1969 Oligocythereis cf. fullonica (Jones & Sherborn); Dépêche, 108, pl. 2, fig. 1.

DERIVATION OF NAME. After the type locality Ranville, Normandy.

DIAGNOSIS. Oligocythereis with dorsomedian ridge bending round posteriorly and bifurcating, one branch extending obliquely forwards terminating just behind valve centre, the other directed posteroventrally. Prominent subcentral tubercle with short posteroventral ridge situated just behind, extending to ventral margin. Anterior and posterior margins may be tuberculate. A short ridge extends anterodorsally from prominent eye tubercle.

MATERIAL. Over 100 valves and carapaces.

HOLOTYPE. Carapace, OS 11821, U. Bathonian Campagnettes Member, (blakeana Zone), Ranville Cement Works, Normandy.

DESCRIPTION. Subquadrate carapace with dorsal angularity produced by prominent eye tubercle and posterodorsal projection of dorsomedian ridge. Surface features as diagnosed. Greatest length of carapace passes through mid-point, greatest height anteriorly through anterior cardinal angle and eye tubercle, greatest width in posterior third. Anterior and posterior margins broadly compressed. Shell surface smooth with a few large sunken normal pore canal openings irregularly scattered. Dorsal and ventral surfaces of carapace V-shaped due to dorsomedian and ventrolateral ridges diverging slightly posteriorly. LV larger than RV which it overlaps along ventral margin and overreaches along posterodorsal and anterodorsal slopes.

Hinge entomodont with 5 terminal teeth anteriorly and posteriorly in RV; smooth median groove expanded anteriorly. Inner margin and line of concrescence coincide; marginal zone wide anteriorly and posteriorly with approximately 24 long slightly curving pore canals anteriorly and 12 posteriorly (see pl. 22, figs. 3, 4). Muscle scars, situated in muscle scar pit, a vertical row of 4 adductors with anterodorsal kidney-shaped frontal scar. Carapace non-dimorphic.

DISTRIBUTION. This is a wide-ranging Bathonian species distributed widely within the study area. Previously it has been recorded from the boueti Bed (U. Bathonian blakeana Zone) of Langton Herring Dorset (Sylvester-Bradley, 1948) and from the U. Bathonian (blakeana Zone) of Lorraine, France. Herein it has been found in beds of L. to U. Bathonian age in the Normandy and Dorset Provinces and U. Bathonian age of the Kent-Boulonnais Province. It is a common Bathonian ostracod, occurring frequently with O. fullonica (Jones & Sherborn).

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11821	.53	.27	.23	F-R.3A.78
paratypes:	car.,	OS 11822	.55	.27	.23	"
	LV,	OS 11823	.56	.28		F-B.2A.78
	RV,	OS 11824	.52	.25		"
	RV,	OS 11825	.57	.30		F-BO.3.79
	car.,	OS 11826	.50	.26	.23	F-R.3A.78

ECOLOGY. A marine species inhabiting both low and high energy environments. Occurs in a variety of sediment types.
REMARKS. This species was originally included in O. fullonica by Sylvester-Bradley (1948) and recognised as being very close to it by Dépêche (1969). The obvious similarity implies a close relationship between the two species. They both range throughout the Bathonian and therefore probably evolved, at the beginning of the Bathonian, from common ancestral stock.

O. ranvillensis appears to be a transitional form between O. fullonica and O. woodwardi Sylvester-Bradley, 1948. In O. woodwardi the ridges are much more swollen; the muscle scar node extends into the posteroventral and anteroventral swollen regions; the ventral ridge is ill-defined. O. woodwardi has, so far, only been found in the U. Bathonian boueti Bed of Langton Herring. It is likely that this evolved from O. ranvillensis with reduction in the angularity of the carapace brought about by further swelling of the existent ridges. The median element of the hinge is further differentiated than in O. ranvillensis.

The marginal pore canals in this species differ from the normal Oligocythereis-type where the canals are long and splayed out like a fan. In O. ranvillensis the canals uniformly all curve upwards.

Oligocythereis capreolata sp. nov.

(Pl. 22, figs. 6 - 10; pl. 23, figs. 1, 2)

1981 Oligocythereis sp. cf. O. fullonica (Jones & Sherborn); Sheppard, in press.

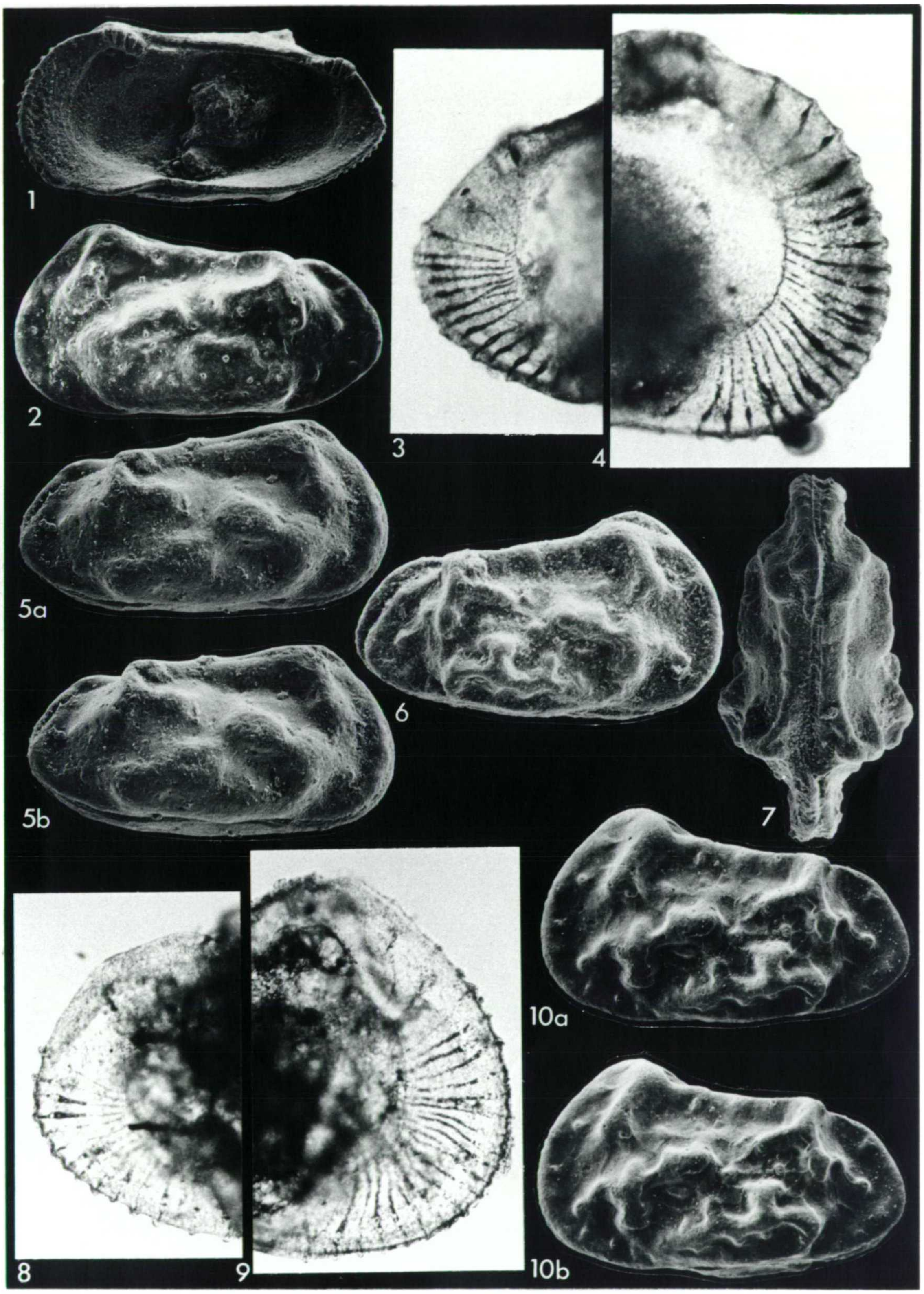
DERIVATION OF NAME. Latin, meaning tendrilled, referring to the prominent ridges which appear curled, like tendrils.
DIAGNOSIS. Oligocythereis with dorsomedian ridge bending round posteriorly and bifurcating, one branch extending forwards a short distance and the other obliquely posteroventrally. Curved ventrolateral ridge, having short branches at irregular intervals, extends from posteroventral position to just beyond ventromedian position. Similar branched ridge extends from valve centre to anteroventral corner. Short, straight ridge extends anterodorsally from eye tubercle.

Explanation of Plate 22

Figs. 1 - 5. Oligocythereis ranvillensis sp. nov.: fig. 1, RV int., OS 11825 (.57 mm long, x 115), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.3.79); figs. 2, 5, holotype, car., OS 11821 (.53 mm long, x 113): fig. 2, L side; fig. 5, stereo-pair of R side, U. Bathonian, Campagnettes Member, Ranville Cement Works (F-R.3A.78); figs. 3, 4, posterior and anterior marginal pore canals, RV, OS 11824 (x 330), U. Bathonian, St. Aubin Member, Bénouville (F-B.2A.78).

Figs. 6 - 10. Oligocythereis capreolata sp. nov.: figs. 6, 10, holotype, car., OS 11493 (.51 mm long, x 117): fig. 6, R side; fig. 10, stereo-pair of L side, U. Bathonian, St. Aubin Member, St. Aubin-sur-mer (F-SA.7.78); fig. 7, car., dors., OS 11827 (.46 mm long, x 130), U. Bathonian, Blainville Member, Ranville Cement Works (F-R.1.79); figs. 8, 9, posterior and anterior marginal pore canals, LV, OS 11828 (x 330), U. Bathonian, as above.

PLATE 22



MATERIAL. 16 valves and carapaces.

HOLOTYPE. Carapace, OS 11493, U. Bathonian, St. Aubin Member, St. Aubin-sur-mer, Normandy.

DESCRIPTION. Subquadrate carapace with rounded outline and smooth margins. Carapace longest medially, highest anteriorly corresponding with dorsal projection at position of eye tubercle, and widest posteriorly. Anterior and posterior margins laterally compressed. Ornament as diagnosed. Shell surface smooth with very faint reticulation over central part of valve. Few large normal pore canal openings with raised collars scattered over surface; reticulation radiates from these (pl. 23, fig. 2). Dorsal and ventral surfaces of carapace V-shaped due to dorsomedian and ventrolateral ridges diverging slightly posteriorly. LV larger than RV which it overlaps along ventral margin and overreaches along posterodorsal and anterodorsal slopes.

Hinge entomodont: RV with 5 terminal teeth anteriorly and posteriorly; smooth median groove, expanded anteriorly. LV with corresponding opposing elements. Inner margin and line of concrescence coincide; marginal zone wide with, anteriorly, approximately 23 long curved cnals, splayed fan-like; posteriorly 12 long, slightly curving canals situated mainly posteroventrally (see pl. 22, figs. 8, 9). Muscle scars a vertical row of 4 adductors with anterodorsally situated kidney-shaped frontal scar.

Carapace non-dimorphic.

DISTRIBUTION. An U. Bathonian species. Apart from the type locality and horizon it has only been found in the U. Bathonian Ranville Member (blakeana Zone) of Normandy and the basal U. Fuller's Earth (polonica Zone) of the Seabarn Farm borehole, Dorset Province.

DIMENSIONS.

			L	H	W	Locality
holotype,	car,	OS 11493	.51	.28	.23	SA.7.78.
paratypes:	car,	OS 11827	.46	.25	.23	F-R.1.79
	LV,	OS 11828	.58	.29		"

ECOLOGY. Shallow water marine.

REMARKS. The pattern of ridges on this species make it distinct from all others of the genus. The 3-branched posterodorsal ridge is present also in O. ranvillensis but there the irregular anteromedian and ventrolateral ridges are lacking. O. fullonica is distinguished by having only a 2-branched posterodorsal ridge and characteristic isolated subcentral tubercle. It is also highly tuberculate and has spinose valve margins. The splayed nature of the marginal pore canals in O. capreolata corresponds with those found in O. fullonica but is quite distinct from the uniformly curved canals of O. ranvillensis.

Oligocythereis sp. 1

(Pl. 23, fig. 2)

REMARKS. A few specimens of a new species of Oligocythereis were found in the U. Bathonian Frome Clay of the Lyme Bay borehole. This resembles O. fullonica (Jones & Sherborn) in all respects except that it has a 3-branched posterodorsal ridge extending down from the dorsomedian ridge, and the subcentral tubercle is attached to a small ridge which extends anteroventrally almost to the ventral margin. The spinose margins and the presence of small antero- and posteroventral tubercles are the same as those of O. fullonica. Apart from the figured specimen, however, the material is not well enough preserved to permit an adequate description and consequently this species is here left under open nomenclature.

Genus Morkhovenicythereis Gründel, 1975

Morkhovenicythereis bouvadensis (Dépêche, 1969)

(Pl. 23, figs. 3, 5 - 7).

1969 Oligocythereis bouvadensis Dépêche, 109, pl. 1, figs. 3, 4; pl. 2, fig. 3.
1975 Morkhovenicythereis bouvadensis (Dépêche); Gründel, 368.
1978 Morkhovenicythereis bouvadensis (Dépêche); Bate, 240, pl. 8, figs. 16, 17.

DIAGNOSIS. Morkhovenicythereis with oblique anterodorsal depression and short posterodorsal ridge; lateral surface wrinkled in appearance. Straight marginal pore canals.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Dépêche, 1969.

Explanation of Plate 23

Figs. 1, 2 Oligocythereis ranvillensis sp. nov.: fig. 1, LV int., OS 11828 (.58 mm long, x 103), U. Bathonian, Blainville Member, Ranville Cement Works (F-R.1.79); fig. 2, holotype, car., OS 11493, detail of normal pore canal opening (x 870), U. Bathonian, St. Aubin Member, St. Aubin-sur-mer (F-SA.7.78).

Figs. 3, 5 - 7. Morkhovenicythereis bouvadensis (Dépêche): figs. 3, 7, LV int., MPA 5999-C6 (.57 mm long): fig. 3, muscle scars (x 750); fig. 7, int. lat. (x 105), U. Bathonian, Fuller's Earth Rock equivalent, depth 213.00 m, Seabarn Farm borehole; figs. 5, 6, car., MPA 5588-C1 (.62 mm long, x 96); fig. 5, R side; fig. 6, dors., U. Bathonian, Frome Clay, depth 169.05 m, Seabarn Farm borehole.

Figs. 4. Oligocythereis sp. cf. O. fullonica (Jones & Sherborn), LV, SAZ 1022-C1 (.57 mm long, x 105), U. Bathonian, Forest Marble, depth 15.00 m, Lyme Bay borehole 74/35.

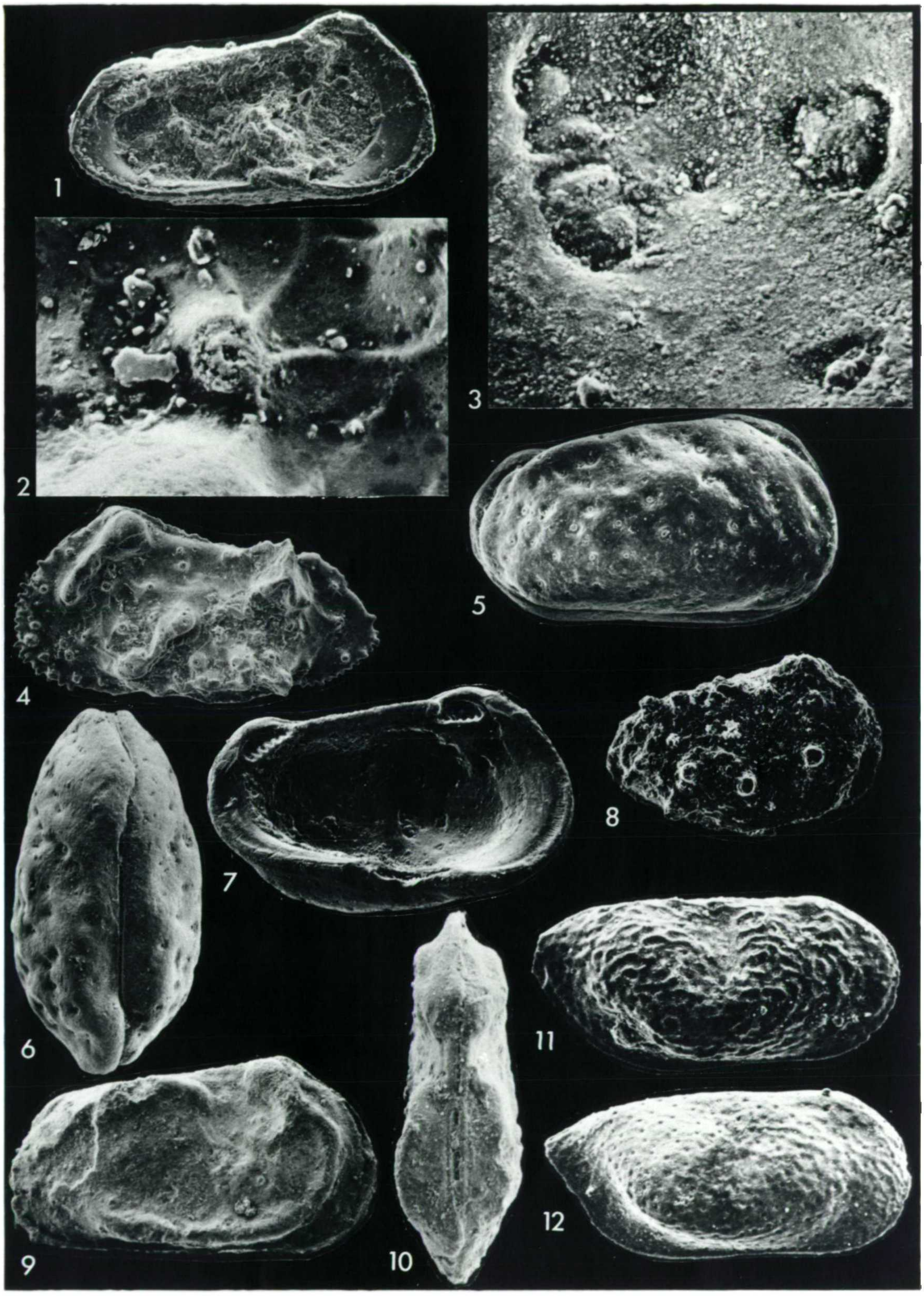
Fig. 8. Trachycythere munita Sylvester-Bradley, juv. RV, BW 28-C1 (.38 mm long, x 118), U. Bathonian, Forest Marble, Fredville borehole.

Figs. 9, 10. Lesleya bathonica Bate, car., JM 1476-C1 (.52 mm long, x 115); fig. 9, R side; fig. 10, dors., U. Bathonian, Forest Marble, Calvert borehole.

Fig. 11. Monoceratina vulsa (Jones & Sherborn), RV, OS 11841 (.48 mm long, x 125), M. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.19.78).

Fig. 12 Monoceratina visceralis (Jones & Sherborn), RV, OS 11844 (.51 mm long, x 117), L. Bathonian, as above (F-PB.36.78).

PLATE 23



DISTRIBUTION. This species ranges from L. to U. Bathonian, having previously been recorded from Lorraine in France and Somerset and Dorset in southern England. Within the study area it occurs in the Normandy and Dorset Provinces as a common element of the fauna from beds of L. to U. Bathonian age, though in England it is more abundant within the L. Bathonian sediments.

ECOLOGY. Marine, shallow water.

REMARKS. M. bouvadensis was removed from Oligocythereis and placed in his new genus Morkhovenicythereis by Gründel (1975), the essential difference between the 2 genera being the marginal pore canals. In Morkhovenicythereis there are approximately 20 canals anteriorly; these are straight and evenly spaced (Dépêche, 1969). In Oligocythereis the number is more often 23 or 24 and these are always distinctly curved. The hinge in M. bouvadensis is interesting because it appears to be half-way between entomodont and amphidont. In the LV the median bar is expanded anteriorly into a knob-like structure but if viewed dorsally this is not the prominent feature of a true amphidont hinge. The median bar is undifferentiated and the expansion of it occurs at the extreme end; this also does not comply with a true entomodont hinge in which the differentiated bar expands gradually and distinctly for about half its length.

Family TRACHYCYTHERIDAE Kozur, 1972

Genus Trachycythere Triebel & Klingler, 1959

Trachycythere munita Sylvester-Bradley

(Pl. 23, fig. 8)

1969 Trachycythere sp. Bate, 428, pl. 16, fig. 3.

1973 Trachycythere munita Sylvester-Bradley, 257-264.

DIAGNOSIS. Small, subquadrate carapace with about 14 cylindrical turretted tubercles, each terminating in a pore. Numerous low-rimmed sieve-type normal pores. Prominent eye tubercle. Marked denticulate ventral carina. Delicate reticulation between tubercles.

MATERIAL. One juvenile valve only.

DESCRIPTION. See Sylvester-Bradley, 1973.

DISTRIBUTION. Known previously from the Bath district of southern England, from the U. Bathonian U. Fuller's Earth (type-horizon) and later (Bate, 1979) from the top of the L. Fuller's Earth, L. Bathonian, ranging up into the U. Fuller's Earth. The single specimen in the study area occurred in the U. Bathonian Great Oolite of the Fredville borehole, Kent-Boulonnais Province.

ECOLOGY. Marine, occupying typically a shelf environment with fine grained clay deposition. The specimen herein, however, occurred in a shallower carbonate environment.

REMARKS. Although a juvenile instar, this specimen is here assigned to T. munita rather than to T. tubulosa Triebel & Klingler, 1959 from the M. Lias of Germany or to T. verrucosa Triebel & Klingler, 1959, from the Lias of Germany and England because of the prominent eye node and presence of a ventral carina.

Genus Lesleya Bate, 1978

Lesleya bathonica Bate, 1978

(Pl. 23, figs. 9, 10)

1978 Lesleya bathonica Bate, 81 - 88.

DIAGNOSIS. Subquadrate carapace with prominent anterior ridge extending from eye node round anterior margin and along ventrolateral margin. A short, curved posterodorsal ridge projects above dorsal margin. Shell surface smooth. Approximately seven anterior marginal pore canals.

MATERIAL. 3 carapaces only.

DESCRIPTION. See Bate, 1978.

DISTRIBUTION. Originally described from the U. Bathonian topmost White Limestone to Forest Marble of the Oxfordshire area (and further recorded from Kirtlington by Ware and Whatley, 1980). It is herein known only from the Forest Marble of the Calvert borehole in the northern part of the Kent-Boulonnais Province.

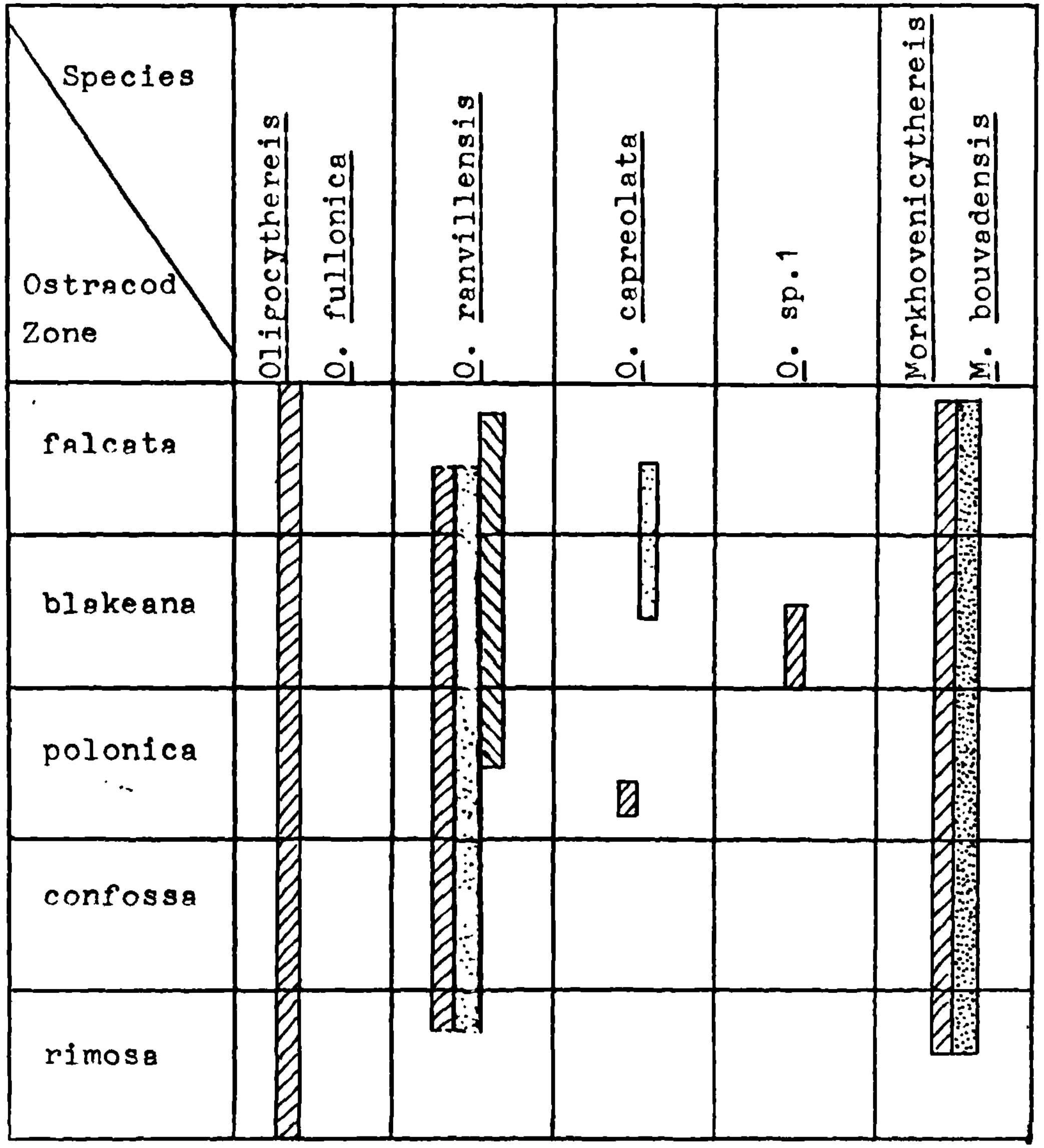


Table 5-11 Range table for members of the Trachyleberididae.

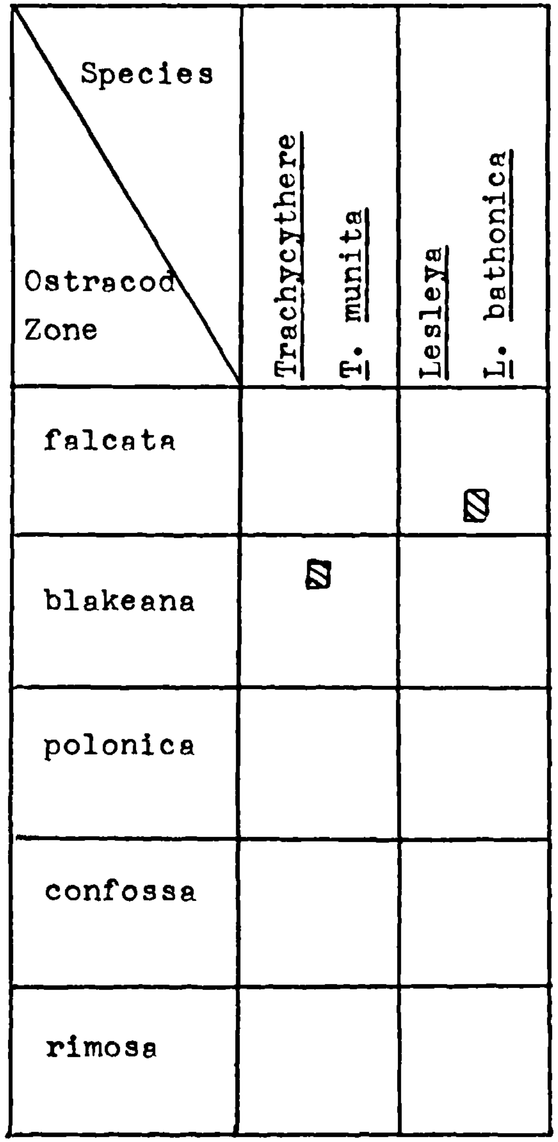


Table 5-12 Range table for members of the Trachycytheridae.

ECOLOGY. A marginal marine ostracod, tolerant of some brackish influence. So far known only from carbonate deposits.

REMARKS. This is the first record of the species outside Oxfordshire. The occurrence within the Calvert borehole agrees with the original idea that this species inhabited the shallow water bordering the old Jurassic shoreline. This is no record of the species in the deeper water sediments further south.

L. bathonica is morphologically similar to Nodophthalmocythere vallata Malz, 1958 but the latter differs by having the marginal ridge distinctly divided anteroventrally, by having a muscle scar depression and in the possession of many, rather than few, straight marginal pore canals.

Family BYTHOCYTHERIDAE Sars, 1926

Genus Monoceratina Roth, 1928

REMARKS. Monoceratina is the longest-ranging of all the cytheracean genera; first recorded from the Devonian it ranges through to the Recent. There has been some doubt in the past as to whether the post-Palaeozoic forms belong to the same genus as their Palaeozoic counterparts but the discovery by Sohn, 1954, of a duplicature and a 5-adductor muscle scar pattern in the latter has tended to dispel this uncertainty.

As a genus, Monoceratina has largely been considered to be both blind, or at least to possess no obvious external eye node, and to be non-dimorphic. M. vulsa (Jones & Sherborn) is one notable exception, however, which Bate (1963) has shown to exhibit size and proportion differences which could be attributable to dimorphism, and also to possess slight antero-dorsal protruberances reminiscent of eye nodes. In the material presented here these 2 features are considered demonstrable to a much greater extent than ever before. M. tumida sp. nov., for example, shows good dimorphism, the presumed females being proportionally much higher than the presumed males, and M. accentuata Sylvester-Bradley exhibits a well pronounced, rounded eye node. In considering the presence or absence of eyes two possible situations could exist. Firstly, we can consider the normal phenotype of Monoceratina to be blind but having the genetic potential to develop sight, this potential only being realised very rarely. Secondly, it is well known that absence of an external eye node is not necessarily evidence of blindness. Monoceratina could, therefore, be a sighted genus in which an external eye node is developed only in response to certain environmental conditions. The latter idea is here accepted as the more likely situation; as eyes are reasonably complex organs it would seem improbable that sight could be developed in certain species only of a blind genus, rather loss of eyes in a sighted genus would be more feasible.

Like the genus, the individual species of Monoceratina are also long-ranging and therefore of little, or no, stratigraphic value.

Monoceratina vulsa (Jones & Sherborn, 1888)

(Pl. 23, fig. 11)

1888 Cytheridea vulsa Jones & Sherborn, 263, pl. 2, figs. 4a, b.

1938 Monoceratina vulsa (Jones & Sherborn); Triebel & Bartenstein, 516, pl. 3, figs. 17, 18.

1963 Monoceratina vulsa (Jones & Sherborn); Bate, 189, pl.3, figs. 5 - 12.

1969 Monoceratina vulsa (Jones & Sherborn); Bate, 400, pl. 7, fig. 5.

1975 Monoceratina vulsa (Jones & Sherborn); Bate & Coleman, 7, pl. 3, figs. 10 - 12.

DIAGNOSIS. Strongly convex (in dorsal view) species of Monoceratina with vertical median sulcus deeply incised, surrounded by prominent swelling strongly undercut ventrolaterally. Shell surface strongly pitted, giving wrinkled appearance.

MATERIAL. Over 100 valves and carapaces.

DISTRIBUTION. A geographically and stratigraphically wide-ranging species, recorded from N. America and Europe. In N. America it has been recorded from the Callovian of Saskatchewan (Brooke & Braun, 1972). In E. Europe it is recorded from the Oxfordian of the Ukraine (Pyatkova

& Permyakova, 1978). In NW Europe it is known from the U. Bathonian of S.Germany (Triebel & Bartenstein, 1938), the M. Callovian of NW Germany (Lutze, 1960), the Bajocian of central and northern England (Bate, 1963) and the L. to U. Bathonian of southern England: U. Bathonian Great Oolite of Richmond (type-locality), L. to U. Bathonian of the Bath area (Bate, 1979) and U. Bathonian of Dorset (Bate & Sheppard, 1981). In the study area it occurs in the U. Bathonian (polonica to falcata Zones) of the Dorset Province and the L. to M. Bathonian (rimosa and confossa Zones) of Normandy.

ECOLOGY. Marine, essentially shallow water, inhabiting a variety of environmental niches and water depths of the continental shelf, as reflected in the widespread distribution.

REMARKS. This is a particularly widespread species of the genus. Its pattern of distribution implies no real direction of dispersal, apart from the westerly movement, associated with the opening of the N. Atlantic, to N. America. In Europe it was extensively present throughout much of the M. and U. Jurassic. In southern England it is here thought to have given rise to M. visceralis (Jones & Sherborn) at the beginning of the Bathonian (see Remarks for that species).

Monoceratina visceralis (Jones & Sherborn, 1888)
(Pl. 23, figs. 12; pl. 24, fig. 1.)

1888 Cytheridea visceralis Jones & Sherborn, 263, pl. 3, figs. 6a - c.
1969 Monoceratina visceralis (Jones & Sherborn); Bate, 399, pl. 7, fig. 3.

DIAGNOSIS. Subrectangular carapace; dorsal and ventral margins parallel. Distinct median sulcus in dorsal half of valve only. Valve convex, prominently swollen posteroventrally. Shell surface strongly pitted. Posteroventral margin slightly serrated.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Bate, 1969.

DISTRIBUTION. This species has previously been recorded from southern England only: the U. Bathonian U. Fuller's Earth (Blue Fuller's Earth

Explanation of Plate 24

Fig. 1. Monoceratina visceralis (Jones & Sherborn), car., dors., OS 11845 (.43 mm long, x 139), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.46.78).

Figs. 2, 4 Monoceratina herburyensis Sylvester-Bradley: fig. 2, LV int., MPA 5000-C3 (.47 mm long, x 127), U. Bathonian, Forest Marble, depth 74.48 m, Seabarn Farm borehole; fig. 3, LV, MPA 5000-C2 (.50 mm long, x 120), U. Bathonian, as above.

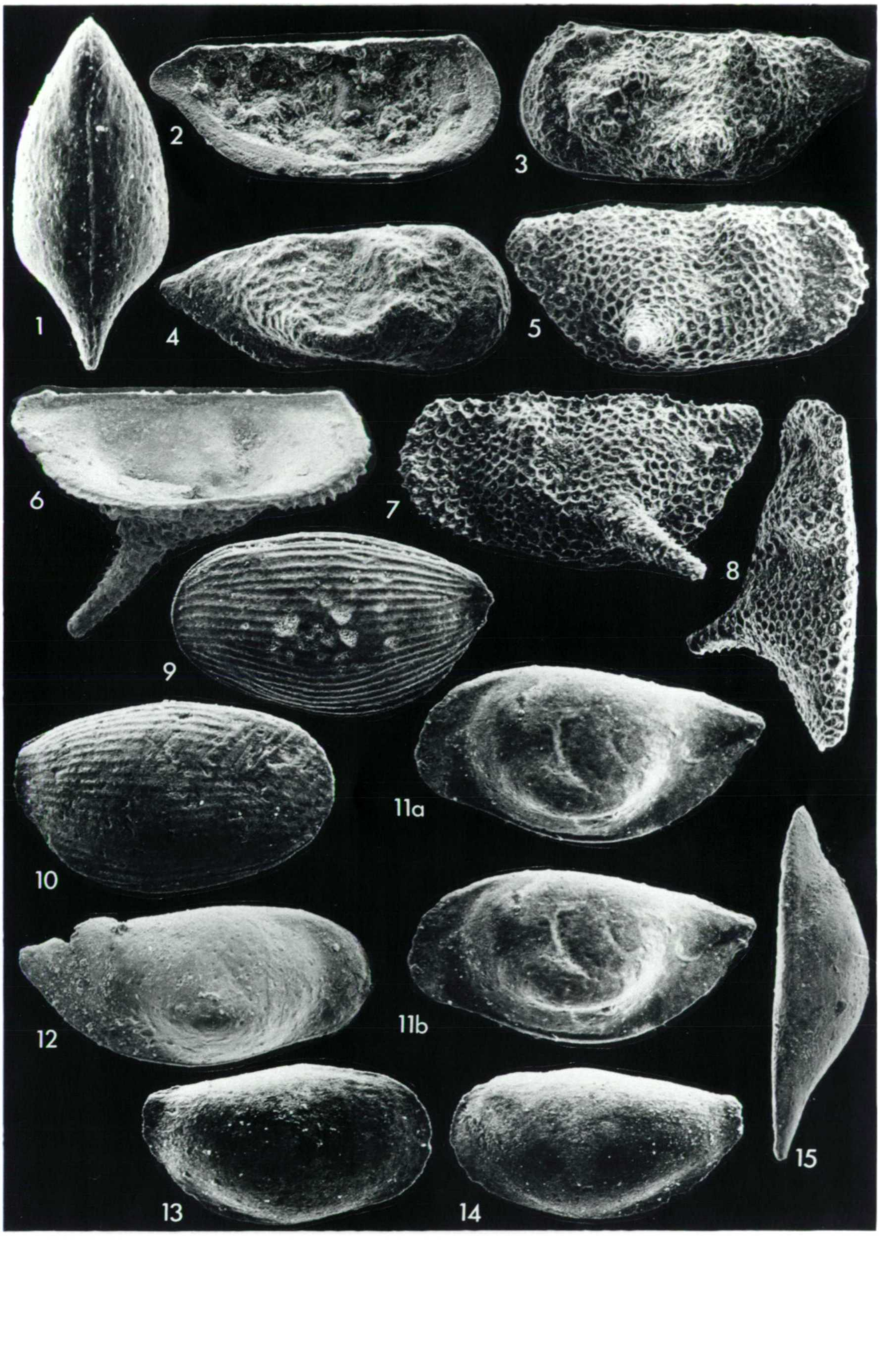
Fig. 3. Monoceratina accentuata Sylvester-Bradley, LV, SAC 2376-C1 (.59 mm long, x 101), U. Bathonian, Forest Marble, depth 51.00 - 51.96 m, Frome borehole.

Figs. 5 - 8. Monoceratina scrobiculata Triebel & Bartenstein: fig. 5, RV, OS 11705 (.64 mm long, x 93), L. Bathonian, Marnes de Port-en-Bessin (F-PB.7.78); figs. 6, 7, LV, OS 11706 (.64 mm long, x 93): fig. 6, int. lat.; fig. 7, ext. lat., L. Bathonian, as above (F-PB.5.78); fig. 8, LV, dors., OS 11707 (.66 mm long, x 90), L. Bathonian, as above.

Figs. 9, 10. Monoceratina striata Triebel & Bartenstein: fig. 9, car., L side, OS 11842 (.39 mm long, x 153), L. Bathonian, as above (F-PB.36.78); fig. 10, car., R side, OS 11843 (.37 mm long, x 162), L. Bathonian, as above (F-PB.38.78).

Figs. 11 - 15. Monoceratina tumida sp. nov.: fig. 11, stereo-pair of holotype, ♀ LV, OS 11834 (.71 mm long, x 84), L. Bathonian, as above (F-PB.8.78); fig. 12, ♂ RV, OS 11835 (.68 mm long, x 88), L. Bathonian, as above (F-PB.9.78); fig. 13, juv. RV, OS 11840 (.41 mm long, x 121), M. Bathonian, as above (F-PB.21.78); fig. 14, juv. LV, OS 11839 (.45 mm long, x 111), M. Bathonian, as above; fig. 15, ♂ RV, dors., OS 11836 (.68 mm long, x 88), L. Bathonian, as above (F-PB.9.78).

PLATE 24



Clay) of Midford, Bath (type-locality) and the L. Fuller's Earth to U. Fuller's Earth (rimosa to polonica Zones) from subsurface sections in the Bath area and Dorset (Bate, 1979, Bate & Sheppard, 1981). Within the study area it occurs from the L. Fuller's Earth to Forest Marble (rimosa to falcata Zones) in the Dorset Province and in the L. Bathonian Marnes de Port-en-Bessin (rimosa Zone) of the Normandy Province.

ECOLOGY. Shallow water marine, occurring mainly within clay facies; is not found within pure carbonate sediments.

REMARKS. M. visceralis is morphologically very close to M. vulsa, the latter having a much more exaggerated ornament with the pits forming a reticulation, and a more pronounced undercutting of the central swollen area. M. vulsa has a longer stratigraphical range and wide geographical distribution than the purely Bathonian M. visceralis. It is here considered possible that M. vulsa gave rise to M. visceralis at the beginning of the Bathonian in the western Paris Basin area, with a simple reduction in the surface pitting and of the ventrolateral swelling. M. visceralis is commonly found in association with M. vulsa within the same samples, suggesting that there was little or no competition between the species, as is often the case between closely related forms.

Monoceratina herburyensis Sylvester-Bradley, 1948

(Pl. 24, figs. 2, 4)

1948 Monoceratina herburyensis Sylvester-Bradley, 188, pl. 15, figs. 3 - 6.

1979 Monoceratina cf. herburyensis Sylvester-Bradley; Bate, fig. 5.

DIAGNOSIS. Elongate carapace with deep dorsomedian sulcus surrounded by four swellings, two ventral swellings tending to coalesce into one curved protruberance. Shell surface covered by shallow irregular pits forming a reticulation.

DESCRIPTION. See Sylvester-Bradley, 1948.

MATERIAL. 67 valves and carapaces.

DISTRIBUTION. Apart from the type level and locality of U. Bathonian boueti Bed (blakeana Zone), basal Forest Marble at Langton Herring, Dorset, this species has only further been recorded from the U. Fuller's Earth (blakeana Zone) within subsurface material in the Bath area (Bate, 1979). Herein it is recorded from the Dorset Province only, from the U. Bathonian Frome Clay and Forest Marble (blakeana and falcata Zones).

ECOLOGY. Marine, shallow water: nearshore shelf environment, relatively high energy.

REMARKS. This species is very similar to M. vulsa; it has the same ornamentation of irregular pits forming a reticulation and differs only in the swollen area surrounding the sulcus being differentiated into discrete ridges. Most of the material examined in fact possesses 3 main swollen areas rather than the 4 present in the holotype but this was regarded by Sylvester-Bradley as variation within the species. M. accentuata Sylvester-Bradley, however, represents a variation of M. herburyensis where the original 4 swollen areas are exaggerated into 4 distinct blunt spines; the variation here being considered worthy of separate specific status. It is interesting to note, in M. herburyensis, the presence of an eye swelling, though admittedly not so distinct as in M. accentuata. The 3 species, M. vulsa, M. herburyensis and M. accentuata all appear to be very closely related.

Monoceratina accentuata Sylvester-Bradley, 1948
(Pl. 24, fig. 3)

1948 Monoceratina accentuata Sylvester-Bradley, 188, pl. 15, fig. 7.

DIAGNOSIS. Monoceratina with dorsomedian sulcus surrounded by four irregular blunt spines. Shell surface reticulate.

MATERIAL. One valve only.

DESCRIPTION. Elongate carapace with rounded anterior margin and posterior margin tapering to a blunt termination approximately a third of shell height below dorsal margin. Dorsal and ventral margins straight, parallel; anterior and posterior cardinal angles prominent. Wide sulcus extends down from mid-dorsal margin to valve centre, around which is crescentic swollen area with 4 prominent blunt spines: 1st ventrolateral, 2nd posterodorsal, 3rd anteroventral, 4th above and behind 3rd. Shell surface covered by coarse reticulation except for smooth area around eye node immediately behind anterior cardinal angle.

Hinge in LV a simple smooth bar.

DISTRIBUTION. Known only from the U. Bathonian *boueti* Bed (*blakeana* Zone) at Langton Herring, Dorset (type-locality) and the Frome Clay (*blakeana* Zone) of the Frome borehole, Dorset.

ECOLOGY. Marine, shallow water, nearshore shelf environment.

REMARKS. *M. accentuata* is here described for the first time (it was originally only diagnosed by Sylvester-Bradley in 1948), the description based on the holotype, In 41907, and the specimen figured herein. It is interesting to note the possession of the well developed eye node in this species; a feature not recorded in the original diagnosis. The rarity of eye nodes in species of *Monoceratina* has previously been discussed under Remarks for the genus.

M. seebergensis Triebel & Bartenstein, 1938 and *M. mesoliassica* Triebel & Bartenstein, 1938, both Lias forms from southern Germany, possess 4 spines as in *M. accentuata*. In both these species, however, the position of the 4th spine differs from that of *M. accentuata*; it is situated anterodorsally, projecting above the dorsal margin whereas in *M. accentuata* it is situated well below this position, just above and behind the 3rd spine. *M. mesoliassica* differs further in lacking the surface reticulation, and they both differ in lacking eye nodes.

Sylvester-Bradley regarded *M. accentuata* as an exaggerated form of the *M. herburyensis* morphotype; this is accepted here (see Remarks for *M. herburyensis*).

Monoceratina scrobiculata Triebel & Bartenstein, 1938

(Pl. 24, figs. 5 - 8)

1938 *Monoceratina scrobiculata* Triebel & Bartenstein, 503, pl. 1, figs. 4a, b; pl. 2, fig. 6.

1979 *Monoceratina scrobiculata* Triebel & Bartenstein; Sheppard, 113-116.

DIAGNOSIS. Species of Monoceratina with single spine; strong reticulation over entire valve surface.

MATERIAL. 47 complete and broken valves.

DESCRIPTION. See Sheppard, 1979.

DISTRIBUTION. M. scrobiculata ranges from L. to U. Jurassic sediments in NW Europe. It has been recorded from the L. Bathonian of Normandy (at Port-en-Bessin by Dépêche, 1973 and Sheppard, 1979; at Villers-sur-mer by Bizon, 1958); from the M. Callovian to the base of the U. Oxfordian at various locations in England and Scotland (Whatley, 1970); from the U. Callovian to L. Oxfordian of N. France (Guyader, 1968); from the U. Bathonian (aspidoides ammonite Zone) to L. Oxfordian of NW. Germany (Lutze, 1960); from the U. Lias and L. Aalenian (type-horizon) of S.Germany; and finally, from the U. Oxfordian of Switzerland (Oertli, 1959). From the study area it is known from the L. Bathonian, lower part of the Marnes de Port-en-Bessin sequence at Bessin, Normandy and from the Dorset Province occurring within the Seabarn Farm borehole only; lower part of the L. Fuller's Earth (batei Subzone of the rimosa ostracod Zone) and the U. Bathonian U. Fuller's Earth (polonica Zone).

ECOLOGY. Marine, shallow shelf environment, preferring a clay/marl facies.

REMARKS. This is a particularly long-spined species of Monoceratina, the spines often as long as half the valve length (Sheppard, 1979) and in well-preserved specimens these are extremely narrow at their ends. Although the carapace itself is considerably strengthened by the robust thick-walled reticulation, a high energy environment is not envisaged owing to the delicate nature of the spines; rather an offshore, shelf type of environment with deposition of fine-grained material but with a certain amount of water movement via channels etc. i.e. the sort of shelf sea which was in existence over much of NW Europe in the Jurassic. Its non-restriction to either a particular lithofacies or to a specific environmental niche, for example a shoreline condition, is reflected in this species' wide dispersal.

Monoceratina striata Triebel & Bartenstein, 1938.

(Pl. 24, figs. 9, 10)

1938 Monoceratina striata Triebel & Bartenstein, 514, pl. 3, figs. 14, 15.

1975 Monoceratina striata Triebel & Bartenstein; Bate & Coleman, 7, pl. 1, figs. 2, 3.

?1975 Monoceratina? multistriata Michelsen, 140, pl. 5, figs. 62, 63.

DIAGNOSIS. Oval, compressed (in dorsal view) carapace with rounded anterior margin, convex ventral margin, blunt posterior margin. Valve surface with numerous shallow but distinct striae longitudinally, parallelling dorsal and ventral margin. Carapace non-sulcate, without alate extensions.

MATERIAL. 23 carapaces.

DESCRIPTION. See Triebel & Bartenstein, 1938.

DISTRIBUTION. M. striata is known from the U. Bathonian of S. Germany (Triebel & Bartenstein, 1938), the L. Aalenian of S. Germany (Fischer, 1962), the U. Aalenian to L. Bajocian of NW. Germany (Plumhoff, 1963) and the L. to M. Toarcian of central England (Bate & Coleman, 1975). A very similar form which is possibly conspecific, M.? multistriata Michelsen, occurs in the L. to U. Sinemurian of the Danish Embayment (Michelsen, 1975). In N. America M. cf. striata is recorded by Brooke & Braun (1972) from the Callovian of Saskatchewan. Herein, the species is recorded from the L. Bathonian L. Fuller's Earth (batei Subzone of the rimosa Zone) and the U. Bathonian U. Fuller's Earth to Forest Marble (polonica to falcata Zones) within the Dorset Province and from the L. Bathonian Marnes de Port-en-Bessin in the Normandy Province.

ECOLOGY. Marine, shelf environment, apparently having no preference for a particular facies.

REMARKS. M. striata has a similar distribution pattern to M. vulsa (Jones & Sherborn) although it is not found east of Germany. It is a very characteristic species and in the study area is found only as a very minor element of the total fauna although being represented within several horizons.

The generic assignment of this species has been queried in the past (e.g. Michelsen, 1975) but for the purposes of this study Monoceratina is retained.

Monoceratina tumida sp. nov.

(Pl. 24, figs. 11 - 15; pl. 25, fig. 1)

DERIVATION OF NAME. Latin, meaning swollen.

DIAGNOSIS. Elongate-oval carapace with rounded anterior margin, deeply convex ventral margin and gently convex dorsal margin. Central part of carapace greatly swollen; swollen area undercut ventrolaterally. Anterior and posterior margins compressed. Shell surface smooth. Carapace apparently dimorphic.

MATERIAL. 34 valves.

HOLOTYPE. Female LV, OS 11834, L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.

DESCRIPTION. Elongate oval carapace with rounded anterior margin, pointed posterior margin situated slightly below dorsal margin. Dorsal margin gently convex; ventral margin deeply convex with slight concavity just behind anterior margin. Lines of greatest height and width of carapace pass through mid-point; greatest length occurs just above mid-point and does not pass through posterior termination. Central part of carapace symmetrically swollen with compressed ventral margin undercutting swollen area. Anterior and posterior margins similarly compressed. Shell surface smooth with small, round normal pore canal openings scattered irregularly over it.

Hinge lophodont with, in RV, long, straight, smooth median bar and insignificant terminal sockets. LV with corresponding smooth median furrow and slight terminal bars. Duplicature wide. Muscle-scars not seen.

DISTRIBUTION. Known from the L. and M. Bathonian Marnes de Port-en-Bessin in the Normandy Province and the L. Bathonian L. Fuller's Earth in the Dorset Province.

DIMENSIONS.

			L	H	Locality
holotype,	♀ LV,	OS 11834	.71	.36	F-PB.8.78
paratypes:	♂ RV,	OS 11835	.68	.30	F-PB.9.78
	♂ RV,	OS 11836	.68	.29	"

Explanation of Plate 25

Fig. 1. Monoceratina tumida sp. nov., holotype, ♀ LV int., OS 11834 (.71 mm long, x 84), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.8.78).

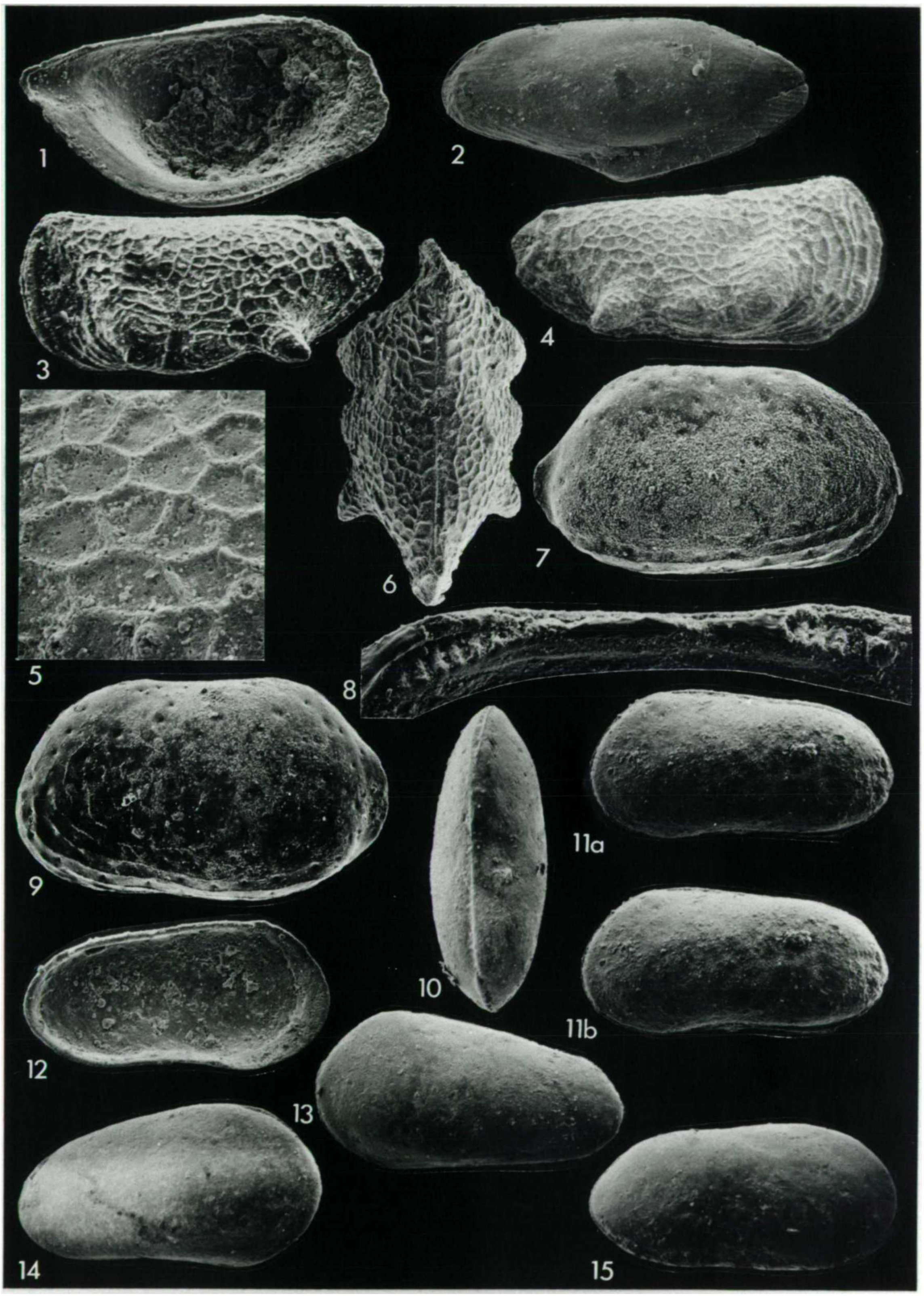
Fig. 2. Monoceratina ? sp. car., L side, BM 5517-C3 (.69 mm long, x 86), U. Bathonian, Forest Marble, St. Margaret's Bay borehole.

Figs. 3 - 6. Bythoceratina ? sp. car., OS 11868 (.62 mm long): fig. 3, L side (x 96); fig. 4, R side (x 96); fig. 5, detail of ornament (x 1K); fig. 6, dors. (x 96), M. Bathonian, Marnes de Port-en-Bessin (F-PB.19.78).

Figs. 7 - 9. Glabellacythere dolabra (Jones & Sherborn): fig. 7, ♀ RV, MPA 4718-C2 (.68 mm long, x 88), U. Bathonian, topmost Forest Marble, depth 19.38 - 19.42 m, Seabarn Farm borehole; figs. 8, 9,♀LV, MPA 4718-C3 (.73 mm long): fig. 8, hinge (x 174); fig. 9, ext. lat. (x 82), U. Bathonian, as above.

Figs. 10 - 15. Aaleniella ? bathonica sp. nov.: figs. 10, 15, car., BM 5538-C2 (.54 mm long, x 92): fig. 10, vent.: fig. 15, R side, U. Bathonian, Forest Marble, St. Margaret's Bay borehole; fig. 11, stereo-pair of holotype, car., L side, BM 5538-C1 (.56 mm long, x 89), U. Bathonian, as above; fig. 12, LV int., MPA 5558-C3 (.51 mm long, x 98), U. Bathonian, Frome Clay, depth 153.50 m, Seabarn Farm borehole; fig. 13, LV, MPA 5558-C2 (.48 mm long, x 104), U. Bathonian, as above; fig. 14, juv. car., R side, MPA 5542-C1 (.44 mm long, x 113), U. Bathonian, as above, depth 145.00 m.

PLATE 25



		L	H	Locality
♂ LV,	OS 11837	.69	.29	F-PB.8.78
♀ LV,	OS 11838	.68	.34	"
juv. LV,	OS 11839	.45	.23	F-PB.21.78
juv. RV,	OS 11840	.41	.23	"

ECOLOGY. A relatively low-energy marine shelf environment, with deposition of fine-grained clay-based sediments.

REMARKS. This is a relatively thin-shelled species of Monoceratina, lacking any form of surface ornament; this, together with the simple hinge-type, probably accounts for the recovery of disarticulated valves only.

M. tumida is similar to M. ungulina Triebel & Bartenstein, 1938, a smooth form from the Lias of S.W. Germany but the latter differs by being sulcate and having the dorsal and ventral margins parallel.

Monoceratina? sp.

(Pl. 25, fig. 2)

1980 Monoceratina? whatleyi Stephens (unpublished Ph.D. thesis)

REMARKS. Two carapaces of an, as yet, unnamed species of ?Monoceratina were recovered from the U. Bathonian Forest Marble (falcata Zone) of the St. Margaret's Bay borehole, Kent-Boulonnais Province. The species has an elongate-oval carapace with faint longitudinal surface striations and a characteristic pinched-out compressed ventral border as a distinct keel. The posterior margin is much more rounded than is usual for the genus and has a low position in relation to the dorsal margin. The same species was found also by Stephens (1980) in the U. Bathonian White Limestone (falcata Zone) of Oxfordshire, which she named M.? whatleyi but which is, as yet, unpublished. In view of the rather long-ranging nature of all other species of the genus, it would seem ill-advised, at this stage, to place any emphasis on the 2 occurrences of this species being in similar U. Bathonian horizons.

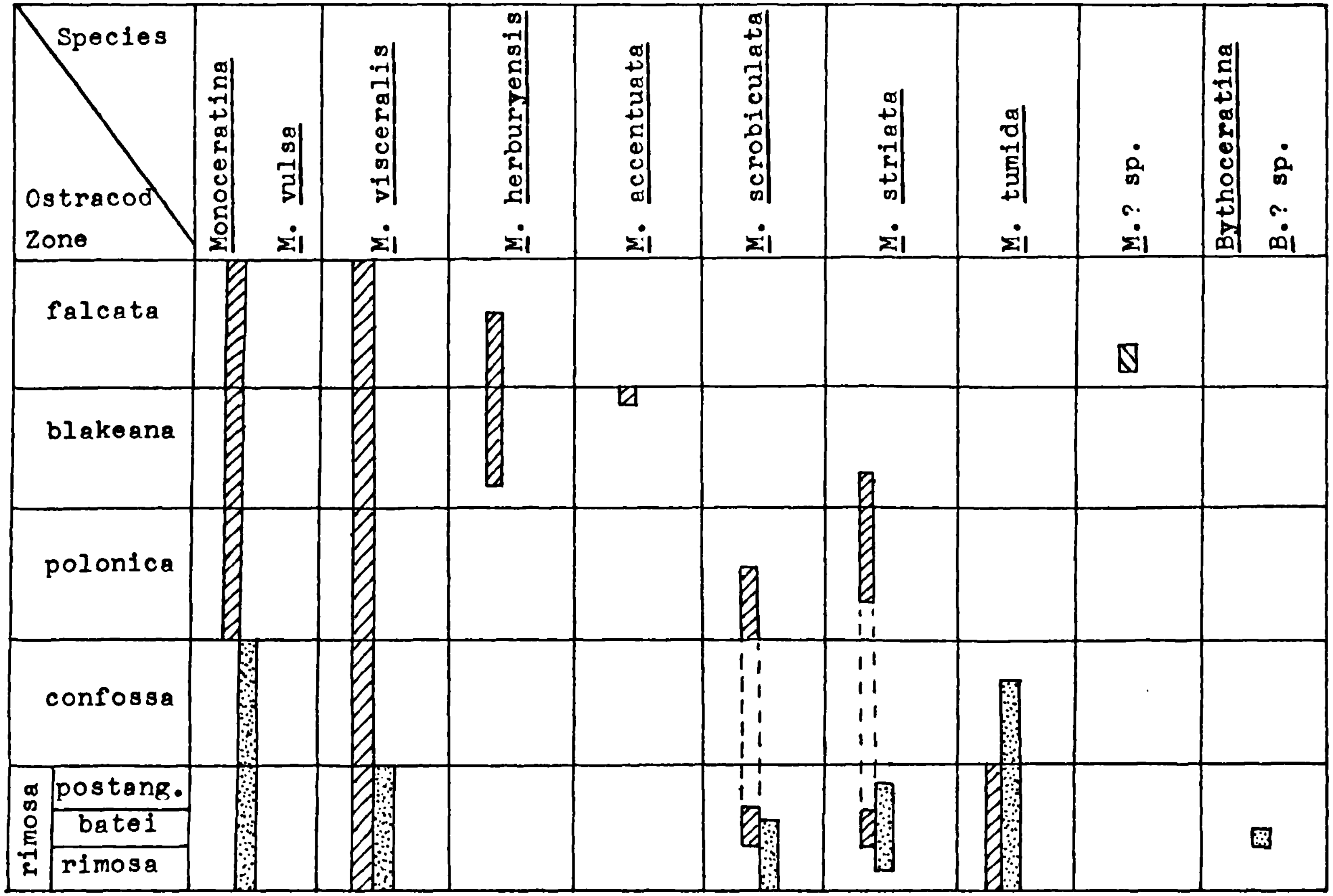


Table 5-13 Range table for the Bythocytheridae.

Genus Bythoceratina Hornibrook, 1952

Bythoceratina? sp.

(Pl. 25, figs. 3 - 6)

REMARKS. Two carapaces of a species, possibly belonging to Bythoceratina, occurred within the L. Bathonian Marnes de Port-en-Bessin in the Normandy Province. The genus is characterised by a dentate median hinge bar, rather than smooth as for Monoceratina, and a positive caudal process with distinct posterior cardinal angle. Without the internal details it is impossible to assign this species more than tentatively to Bythoceratina. The species is characterised by a long straight dorsal margin with prominent anterior and posterior cardinal angles, rounded anterior margin, triangular posterior margin with caudal process, 3 short blunt ventrolateral spines and a well developed reticulation over the valve surfaces. Distinct normal pore canal openings are seen within the murae of the reticulation.

Family CYTHERIDEIDAE Sars, 1925

Subfamily CYTHERIDEINAE Sars, 1925

Genus Glabellacythere Wienholz, 1967

Glabellacythere dolabra (Jones & Sherborn, 1888)

(Pl. 25, figs. 7 - 9)

1888 Cytheridea dolabra Jones & Sherborn, 267, pl. 3, figs. 3a - c.

1969 Hadrocytheridea dolabra (Jones & Sherborn); Bate, 407, pl. 9, figs. 1 - 8; pl. 10, fig. 1.

1978 Glabellacythere dolabra (Jones & Sherborn); Bate, 238, pl. 7, figs. 13 - 15.

DIAGNOSIS. Robust, dimorphic carapace. Shell surface finely punctate with widely scattered, large circular pits, each with a circular normal pore canal opening.

MATERIAL. 64 valves and carapaces.

DESCRIPTION. See Bate, 1969.

DISTRIBUTION. G. dolabra has been recorded from U. Bathonian sediments only; it ranges from the basal U. Fuller's Earth to Forest Marble (polonica to falcata ostracod Zones) within Somerset and Dorset (Bate, 1978, 1979; Bate & Sheppard, 1981). It is recorded herein from the Forest Marble of the Dorset Province and the Kent-Boulonnais Province (English sector only) and U. Bathonian Langrune Member (falcata Zone) of Normandy.

ECOLOGY. This robust ostracod would have been well suited to a near-shore shelf, relatively high-energy environment, largely occurring in U. Bathonian times.

REMARKS. G. dolabra is similar in all respects to G. nuda Wienholz, 1967 from the Callovian of Germany, E. France (Dépêche, 1969) and southern England (Kilenyi, 1978), except that the latter has distinct anterior and posterior vestibules. It would seem likely that G. nuda evolved from G. dolabra, with the formation of vestibules resulting from some change in the physico-chemical environment at the beginning of the Callovian. Peypouquet (1980) considers that vestibule size is directly related to the amount of dissolved oxygen in the water, with the size increasing with decreasing amounts of dissolved oxygen. It is not known, however, whether actual vestibule formation is similarly controlled.

Subfamily EUCYTHERINAE Puri, 1953

Genus Aaleniella Plumhoff, 1963

Aaleniella? bathonica sp. nov.

(Pl. 25, figs. 10 - 15)

DERIVATION OF NAME. After the stage in which this species occurs.

DIAGNOSIS. Elongate carapace with rounded anterior and posterior margins; dorsal and ventral margins taper slightly to posterior. Shell surface smooth, featureless.

MATERIAL. 71 valves and carapaces.

HOLOTYPE. Carapace, BM 5538-C1, U. Bathonian Forest Marble (falcata ostracod Zone), St. Margaret's Bay borehole, Kent-Boulonnais Province.

DESCRIPTION. Elongate-rectangular carapace with rounded anterior and posterior margins. Dorsal margin straight, ventral margin with median concavity; carapace tapers slightly to posterior. Greatest length of carapace passes through mid-point, greatest height through anterior cardinal angle, greatest width through mid-point. Shell surface smooth. LV larger than RV which it overlaps ventrally and overreaches along posterodorsal and anterodorsal slopes.

Hinge lophodont with, in LV, terminal shallow sockets and a long smooth median bar. Inner margin and line of concrescence do not coincide: small vestibules produced anteriorly and posteriorly. Marginal zone of moderate width anteriorly; narrower posteriorly. Pore canals apparently few and straight though precise number not known. Muscle scars not observed.

Carapace non-dimorphic.

DISTRIBUTION. A? bathonica is here recorded from U. Bathonian sediments only; from the U. Fuller's Earth to the Forest Marble (polonica to falcata Zones) in the Dorset Province and from the Forest Marble and equivalent beds within the subsurface and outcrop material of the Kent-Boulonnais Province.

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	BM 5538-C1	.56	.27	.22	St. Margaret's Bay
paratypes:	car.,	BM 5538-C2	.54	.26	.21	"
	RV,	MPA 5558-C1	.49	.25		Seabarn 153.50 m
	LV,	MPA 5558-C2	.48	.24		"
	LV,	MPA 5558-C3	.51	.24		"
	car.,	MPA 5558-C4	.53	.25	.21	"
	-1 car.,	MPA 5542-C1	.44	.23	.18	Sea barn 145.00 m

ECOLOGY. Marine, shallow water.

REMARKS. This is the youngest record of the genus in the Middle Jurassic. Aaleniella was originally described from the U. Aaelenian of NW Germany by Plumhoff, in 1963. His type species, A. compressa, has since been recorded from the M. Toarcian of central England by Bate and Coleman (1973). A. compressa differs from the present species by tapering markedly to the posterior when viewed laterally as well as dorsally, the greatest width occurring anteriorly. Plumhoff also described an unnamed species, A. sp.1

from the German material which laterally is similar to A. ? bathonica but in dorsal view is widest anteriorly. The generic assignment of the present species is queried owing to the uncertain internal details; the muscle scar arrangement and the number of marginal pore canals.

Subfamily GALLIAECYTHERIDEINAE Andreev and Mandelstam, 1964

Genus Angliaecytheridea nov.

DERIVATION OF NAME. Latin Anglia, England, the country of origin + cytheridea.

GENDER. Feminine.

DIAGNOSIS. Small to medium-sized genus of Galliaecytherideinae; subquadrate carapace with compressed anterior and posterior marginal borders, posterior caudal process. Left valve larger than right; in right valve a slight dorsomedian convexity in dorsal margin. Valves overhang ventral margin posteroventrally. Hinge antimerodont; inner margin and line of concrescence nt coincident, shallow vestibules anteriorly and posteriorly. Marginal pore canals few, straight, widely spaced.

TYPE SPECIES. Angliaecytheridea calvata sp. nov.

REMARKS. The subquadrate shape and compressed margins of this genus are common to many other Bathonian genera. Glyptocythere Malz, 1962 is perhaps the closest genus to it in external morphology but internally differs by having an entomodont hinge and in the absence of vestibules. Galliaecytheridea Oertli, 1957 has a similar male outline but the females are distinctly ovate and there is no caudal process; in Angliaecytheridea the female dimorph retains the subquadrate shape but is proportionally higher than the male. The antimerodont hinge, muscle scar pattern, presence of vestibules and possession of only few marginal pore canals enable Angliaecytheridea to be placed within the Galliacytherideinae.

The genus is, at present, monotypic.

Angliaecytheridea calvata gen. et sp. nov.

(Pl. 26, figs. 1 - 8; text-fig. 5 - 6)

DERIVATION OF NAME. Latin, calvus, meaning smooth.
DIAGNOSIS. Smooth species of Angliaecytheridea with inflated, subquadrate carapace and well compressed anterior and posterior margins. Dimorphic.
MATERIAL. 56 valves and carapaces.
HOLOTYPE. Male carapace, MPA 5514-C1, U. Bathonian Frome Clay (blakeana ostracod Zone), Seabarn Farm borehole, depth 131.50 m, Dorset.
DESCRIPTION. Subquadrate carapace with well rounded anterior margin, small triangular posterior margin with caudal process. Prominent anterior and posterior cardinal angles. Dorsal margin sloping gently to posterior; straight in LV, in RV a slight but distinct median convexity. Carapace swollen when viewed dorsally with maximum width just behind mid-point; maximum height occurs through anterior cardinal angle, maximum length medially. Slight lateral overlap of valves over ventral margin dorsoventrally. Anterior and posterior margins well compressed. Ventral margin slightly incurved medially; posteroventral slope steep and straight. LV larger than RV which it overlaps dorsally, especially in region of anterior cardinal angle, and ventrally and overreaches posterodorsally and posteroventrally. Shell surface smooth with numerous small normal pore canal openings scattered irregularly over surface. Carapace dimorphic with females being proportionally higher than males.

Hinge antimerodont with, in RV, terminal dentate ridges possessing 5 teeth anteriorly and posteriorly, and a locellate median groove. LV median bar with very shallow accommodation groove above. Inner margin and line of concrescence not coincident; very shallow vestibules produced anteriorly and posteriorly. Marginal pore canals straight, undivided and few in number; approximately 8 anteriorly and 5 posteriorly (see fig. 5 - 6). Muscle-scars a vertical row of four adductors with one oval frontal and an oval mandibular scar.
DISTRIBUTION. This species has been found only within the Lyme Bay borehole and Seabarn Farm borehole, Dorset Province, occurring within the Frome Clay (blakeana Zone), U. Bathonian.

Explanation of Plate 26

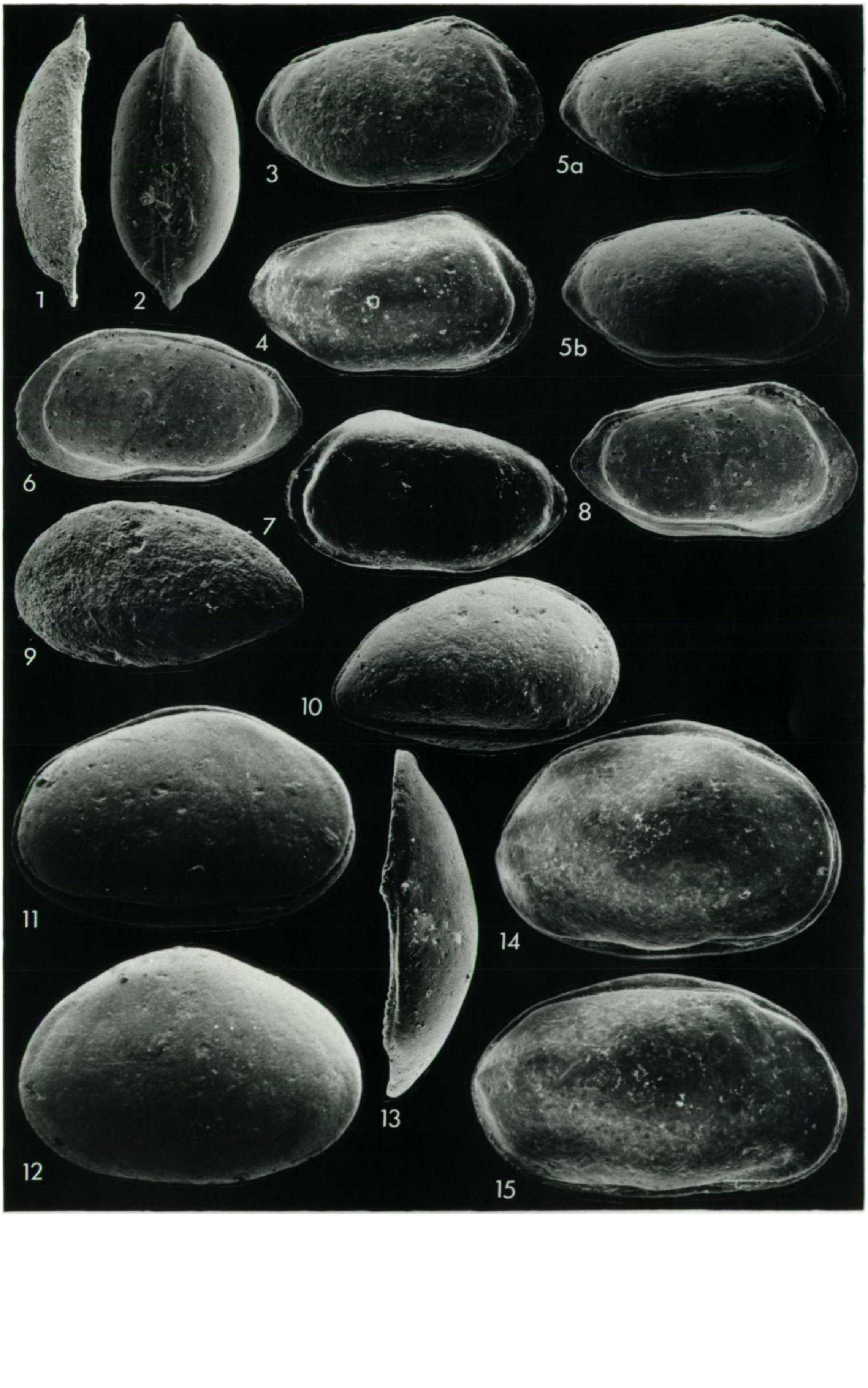
Figs. 1-8. Angliaecytheridea calvata gen. et sp. nov.: fig. 1, ♂ RV, dors., MPA 5514-C3 (.51 mm long, x 98), U. Bathonian, From Clay, depth 131.50 m, Seabarn Farm borehole; figs. 2, 4, ♂ car., SAZ 1017-C1 (.50 mm long, x 100): fig. 2, vent.; fig. 4, R side, U. Bathonian, Forest Marble, depth 10.00 m, Lyme Bay borehole 74/35, fig. 3, ♀ car., R side, MPA 5514-C2 (.47 mm long, x 106), U. Bathonian, Frome Clay, as above; fig. 5, stereo-pair of holotype, ♂ car., R side, MPA 5514-C1 (.48 mm long, x 104), U. Bathonian, as above; fig. 6, RV int., SAZ 1017-C3 (.46 mm long, x 108), U. Bathonian, Forest Marble, as above; fig. 7, ♂ car., L side, MPA 5514-C4 (.48 mm long, x 104), U. Bathonian, Frome Clay, as above; fig. 8,♂LV int., SAZ 1017-C2 (.49 mm long, x 102), U. Bathonian, Forest Marble, as above.

Figs. 9, 10. Pichottia muris Oertli: fig. 9, car., L side, MPA 4785-C1 (.39 mm long, x 128), U. Bathonian, Forest Marble, depth 52.05 m, Seabarn Farm borehole; fig. 10, car., R side, MPA 4785-C2 (.38 mm long, x 130), U. Bathonian, as above.

Figs. 11, 12. Praeschuleridea subtrigona subtrigona (Jones & Sherborn); fig. 11, ♂ car., R side, MPA 5567-C3 (.59 mm long, x 100), U. Bathonian, Frome Clay, depth 158.50 m, Seabarn Farm borehole; fig. 12, ♀ LV, MPA 5567-C4 (.57 mm long, x 105), U. Bathonian, as above.

Figs. 13 - 15. Praeschuleridea quadrata Bate: fig. 13, ♀ RV, dors., MPA 5514-C8 (.68 mm long, x 88), U. Bathonian, as above, depth 131.50 m; fig. 14, ♀ car., R side, MPA 5514-C6 (.68 mm long, x 88), U. Bathonian, as above; fig. 15, ♂ car., R side, MPA 5514-C7 (.76 mm long, x 78), U. Bathonian, as above.

PLATE 26



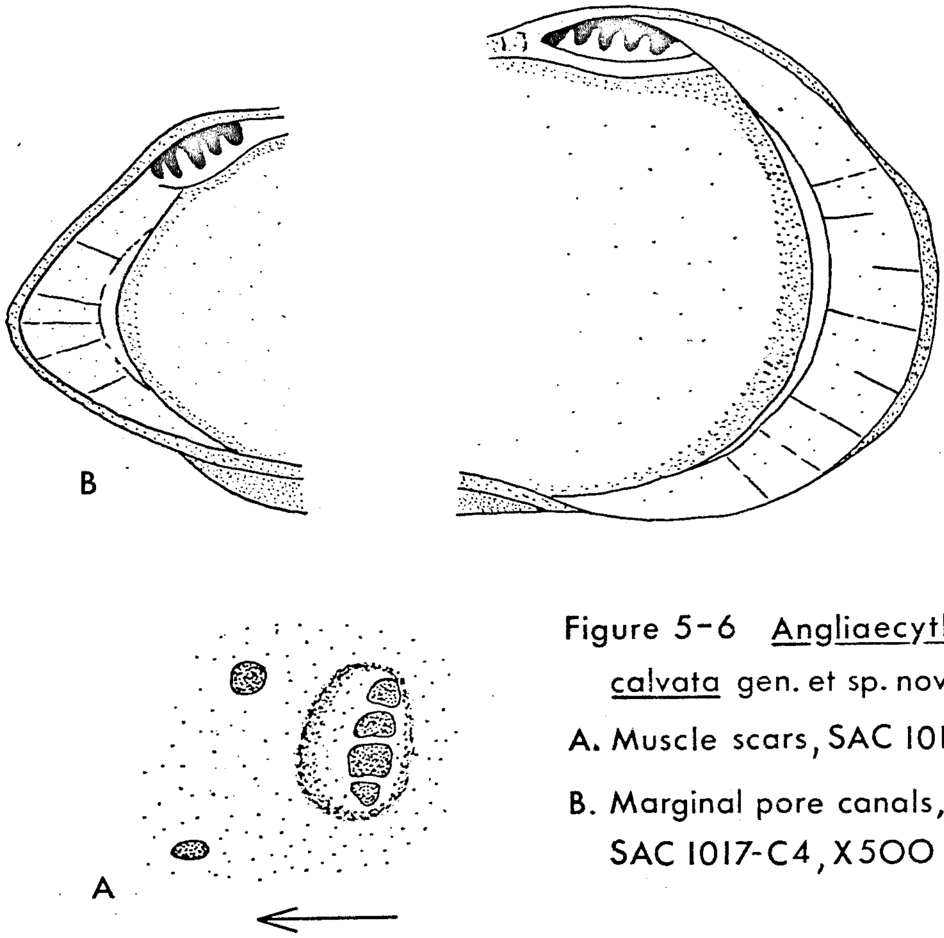


Figure 5-6 Angliaecytheridea calvata gen. et sp. nov.

A. Muscle scars, SAC 1017-C3, X300

B. Marginal pore canals, SAC 1017-C4, X500

DIMENSIONS.

			L	H	W	Locality
holotype,	♂ car.,	MPA 5514-C1	.48	.27	.22	Seabarn 131.50 m
paratypes:	♀ car.,	MPA 5514-C2	.47	.29	.21	"
	♂ RV.,	MPA 5514-C3	.51	.27		"
	♂ car.,	SAZ 1017-C1	.50	.27	.22	Lyme Bay 10.00 m
	♂ LV,	SAZ 1017-C2	.49	.27		"
	♂ RV,	SAZ 1017-C3	.46	.25		"
	♂ car.,	MPA 5514-C4	.48	.26	.22	Seabarn 131.50 m
	♀ car.,	MPA 5514-C5	.51	.29	.21	"
	♂ LV,	SAZ 1017-C4	.50	.26		Lyme Bay 10.00 m

ECOLOGY. A marine species, inhabiting a relatively low-energy shelf environment.

REMARKS. This new species is restricted both geographically and stratigraphically and, until further specimens of it are found elsewhere, is of little stratigraphic significance.

Genus Pichottia Oertli, 1959

Pichottia muris Oertli, 1959

(Pl. 26, figs. 9, 10)

1959 Pichottia muris Oertli, 116, pl. 1, figs. 1 - 10.

1979 Pichottia muris Oertli; Bate, fig. 5.

DIAGNOSIS. Small species of Pichottia (♀ length .37 - .41 mm; ♂ .43 - .47 mm), oval in laterial view with convex dorsal and ventral margins.

MATERIAL. 43 valves and carapaces.

DESCRIPTION. See Oertli, 1959.

DISTRIBUTION. Apart from the type locality, U. Bathonian, "Les Pichottes" Quarry, Boulogne, P. muris has been recorded from L. to U. Bathonian sediments (L. Fuller's Earth to U. Fuller's Earth) of the Bath area of southern England (Bate, 1979). It is here recorded from the U. Bathonian Forest Marble of the Dorset Province and the Kent-Boulonnais Province (subsurface material as well as outcrop material from the type-locality).

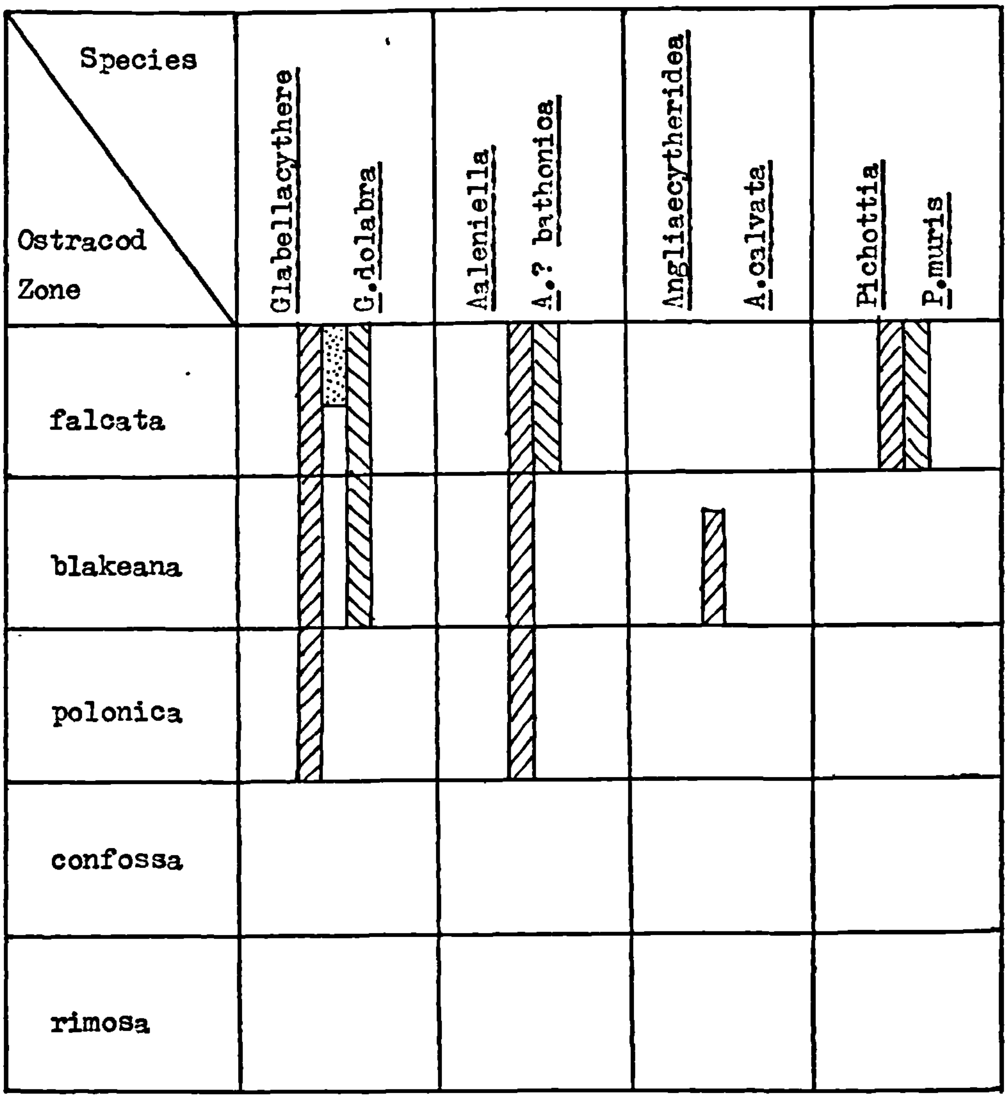


Table 5-14 Range table for members of the Cytherideidae.

ECOLOGY. A marine species inhabiting shallow waters, close to land and probably, therefore, tolerant of fluctuations in salinity.

REMARKS. This is distinguished from P. magnamuris Bate, 1967 from the U. Bathonian of eastern England and from P. elegans Ware & Whatley, 1980 from the U. Bathonian of Oxfordshire largely on size. P. magnamuris is considerably larger (♀ length .61 - .69; ♂ .68 - .76 mm); P. elegans is also larger (length .55 - .58 mm), non-dimorphic and more slender.

Family SCHULERIDEIDAE Mandelstam, 1959

Subfamily SCHULERIDEINAE Mandelstam, 1959

Genus Praeschuleridea Bate, 1963

DIAGNOSIS (emended). Carapace ovoid in outline, ornamented or smooth. Hinge paleohemimerodont. Greatest length of carapace along midlength. Marginal pore canals arranged fan-like, curving outwards away from a line drawn through mid-point, 12 - 30 anteriorly, 4 - 8 posteriorly. Muscle scars a crescentic row of 4 adductor scars with centrally situated anterior frontal scar, rounded or sometimes kidney-shaped.

TYPE SPECIES. Cytheridea subtrigona Jones & Sherborn, 1888.

REMARKS. The diagnosis is here emended to include a larger number of marginal pore canals than was originally stated for the genus. The original diagnosis stated 12 - 16 canals anteriorly and 4 - 6 posteriorly; P. quadrata Bate, however, has 20 - 30 anteriorly and 6 - 8 posteriorly.

Praeschuleridea subtrigona subtrigona (Jones & Sherborn, 1888)

(Pl. 26, figs. 11, 12)

1888 Cytheridea subtrigona Jones & Sherborn, 265, pl. 2, figs. 9a - c.

1963 Praeschuleridea subtrigona (Jones & Sherborn); Bate, 207, pl. 12, figs. 12 - 16; pl. 13, figs. 1 - 9.

1969 Praeschuleridea subtrigona subtrigona (Jones & Sherborn); Bate, 405, pl. 8, figs. 4 - 6.

1978 Praeschuleridea subtrigona (Jones & Sherborn); Bate, 244, pl. 10, fig. 1.

DIAGNOSIS. Subspecies of P. subtrigona with subtrigonal (in lateral view) carapace. Right valve more elongate than left, more acuminate posteriorly. Shell surface finely punctate. Length of adult carapace of the order of (female) .56 mm; (male) .58 mm.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Bate, 1963.

DISTRIBUTION. P. subtrigona subtrigona has a long stratigraphical range, having been recorded from the L. Bajocian of central and northern England (Bate, 1963, 1964), the U. Bathonian U. Fuller's Earth of Midford, Bath (type locality, Jones & Sherborn, 1888) and from L. to U. Bathonian L. Fuller's Earth to U. Fuller's Earth (rimosa to blakeana ostracod Zones) of the Bath area (Bate, 1979). Herein the subspecies occurs in the U. Bathonian sediments of the Kent-Boulonnais Province, L. to U. Bathonian of the Dorset Province and U. Bathonian (polonica to falcata Zones) of the Normandy Province.

ECOLOGY. Marine, shallow water, occurring within high and low energy environments, clay and carbonate facies.

REMARKS. Three subspecies of P. subtrigona have been recognised (Bate, 1964, 1965) which are differentiated on size alone. P. subtrigona subtrigona is the smallest with P. subtrigona intermedia and P. subtrigona magna representing the larger subspecies. The latter two subspecies are much shorter ranging and are restricted to the Bajocian Stage. Apart from the size consideration, which is of prime importance, P. subtrigona subtrigona is distinguished from the Bathonian species P. quadrata Bate, 1963 by its uniformly arched dorsal outline in the RV as well as the LV; in P. quadrata the RV has a straight dorsal margin with a prominent posterior cardinal angle. It is interesting here to note that P.s. subtrigona and P. quadrata seldom occur together although the ranges of the two coincide in the U. Bathonian of southern England. P.s. subtrigona is also more widely distributed geographically than P. quadrata, occurring, albeit rarely, in the Normandy Province. This implies that P.s. subtrigona had a somewhat higher level of tolerance of changing environmental conditions.

Praeschuleridea quadrata Bate, 1967

(Pl. 26, figs. 13 - 15; pl. 27, fig. 1)

1967 Praeschuleridea quadrata Bate, 42, pl. 9, figs. 1 - 12.

1978 Praeschuleridea quadrata Bate, 244, pl. 10, figs. 2, 3.

DIAGNOSIS. Praeschuleridea with oval carapace in male dimorph, subquadrate in female. Distinctly angled posterior cardinal angle, arched dorsal margin in left valve. Shell surface punctate. Hinge weakly paleohemimerodont. Marginal pore canals 20 - 30 anteriorly, 6 - 8 posteriorly.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Bate, 1967.

DISTRIBUTION. Originally described from the U. Bathonian U. Estuarine Series of eastern England, this species is here recorded from the U. Bathonian Frome Clay to Forest Marble (polonica to falcata Zones) of the Dorset Province and the U. Bathonian Forest Marble and French equivalent (falcata Zone) of the Kent/Boulonnais Province. It is unknown from Normandy.

ECOLOGY. Shallow water marine, occurring within clay and carbonate facies rock-types.

REMARKS. The pronounced posterior cardinal angle and large size of its carapace make this species distinct from all others of the genus. P. subtrigona (Jones & Sherborn, 1888) is smaller (length .50 mm ♀♀, .53 mm ♂♂ compared with length .64 mm ♀♀ , .79 mm ♂♂ for P. quadrata) and the dorsal margin of the RV is more evenly arched. Schuleridea pentagonalis Swartz & Swain (1946, 368, pl. 53, figs. 1 - 8) from the U. Jurassic of N. America is of similar dimensions to P. quadrata but differs in the dorsal outline of the LV which is not so strongly convex.

Praeschuleridea confossa Sheppard, 1981

(Pl. 27, figs. 2 - 6)

Explanation of Plate 27

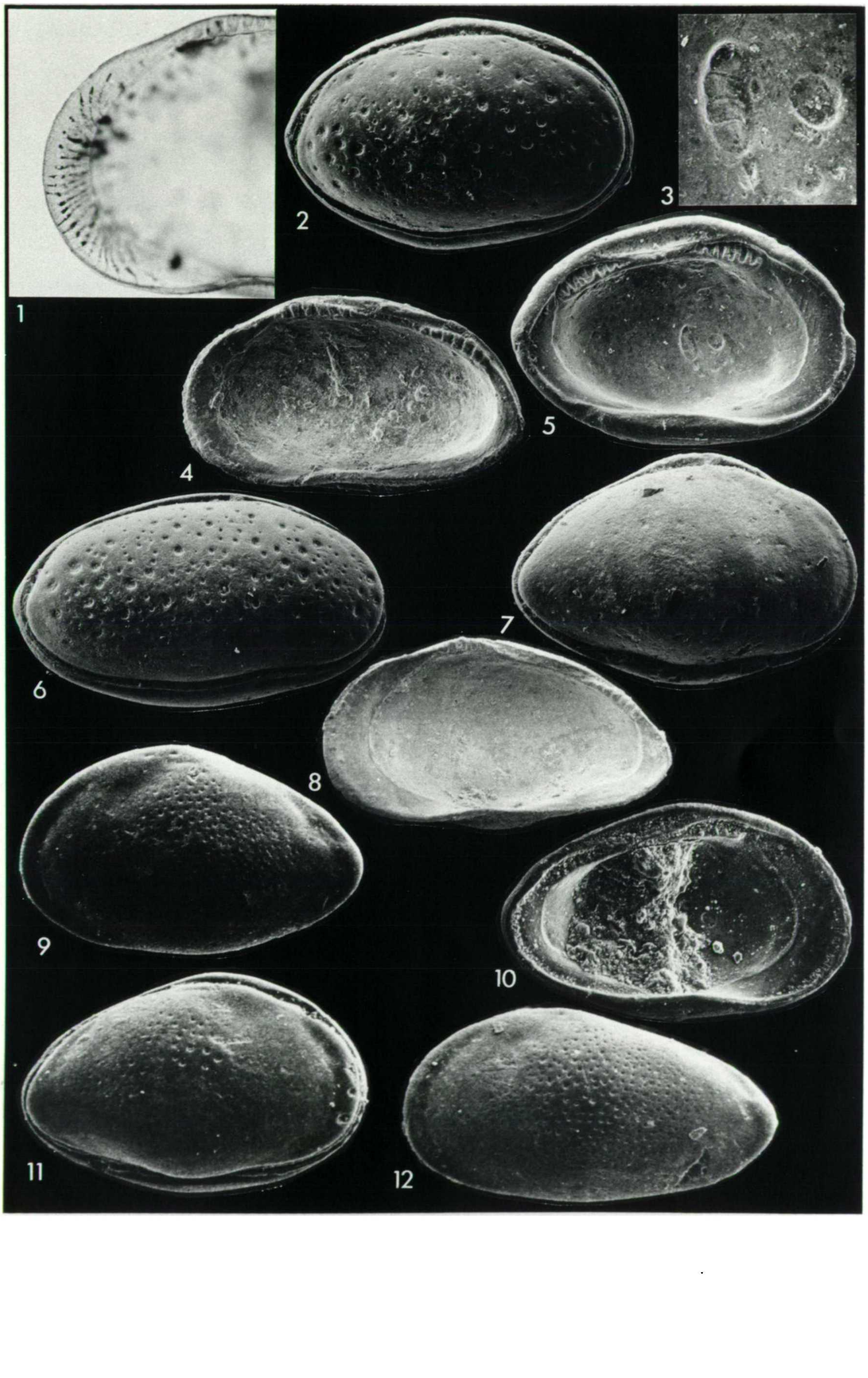
Fig. 1. Praeschuleridea quadrata Bate, anterior marginal pore canals of ♀ RV, MPA 5514-C9 (x 150), U. Bathonian, FromeClay, depth 131.50 m, Seabarn Farm borehole.

Figs. 2 - 6. Praeschuleridea confossa Sheppard: fig. 2, ♀ car., R side, MPK 2785 (.55 mm long, x 109), M. Bathonian, top of L. Fuller's Earth, depth 230.00 m, Seabarn Farm borehole; figs. 3, 5, ♀ LV, MPK 2786 (.56 mm long): fig. 3, muscle scars (x 270); fig. 5, int. lat. (x 107), U. Bathonian, basal Frome Clay, depth 169.05 m, as above; fig. 4, ♂ RV int., MPK 2789 (.50 mm long, x 120), U. Bathonian, top of U. Fuller's Earth, depth 170.66 m, as above; fig. 6, ♂ car., R side, MPK 2787 (.56 mm long, x 116), M. Bathonian, top of L. Fuller's Earth, depth 230.00 m, as above.

Fig. 7. Schuleridea (Eoschuleridea) bathonica Bate, ♀ car., R side, MPA 5188-C1 (.53 mm long, x 113), U. Bathonian, Forest Marble, depth 94.00 m, Seabarn Farm borehole.

Figs. 8 - 12. Schuleridea (Eoschuleridea) batei Dépêche: fig. 8, ♀ RV int., OS 11851 (.55 mm long, x 109); fig. 9, ♀ LV, OS 11482 (.59 mm long, x 101); fig. 10, ♀ LV int., OS 11850 (.55 mm long, x 109); fig. 11, ♀ car., R side, OS 11853 (.54 mm long, x 111). All L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.6.78). Fig. 12, ♂ LV, OS 11852 (.63 mm long, x 95), L. Bathonian, as above (F-PB.5.78).

PLATE 27



1978 Praeschuleridea sp. A. Bate, 222, pl. 10, figs. 4 - 6.

1981 Praeschuleridea confossa Sheppard (in press)

DIAGNOSIS. Species of Praeschuleridea with surface ornament of subrounded pits of varying size.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Sheppard, 1981.

DISTRIBUTION. First appearing at the base of the M. Bathonian Zone of the same name, the confossa Zone, this species is a common faunal element in the Bath area (Bate, 1978, 1979) and the Dorset Province where it ranges up into the falcata Zone, Forest Marble from the topmost beds of the L. Fuller's Earth. In the Kent-Boulonnais Province it occurs from the "Fuller's Earth" (probably Fuller's Earth Rock, confossa Zone) to the Forest Marble (falcata Zone) in the subsurface material only. The species has not been found in France or elsewhere in Europe.

ECOLOGY. A marine shelf form, inhabiting most environments, occurring within clay and limestone facies but not within high energy littoral habitats.

REMARKS. This species is morphologically very similar to P. batei Whatley, 1970 (316, pl. 2, figs. 3, 4, 9 - 22), found in Callovian sediments (macrocephalus to lamberti ammonite Zones) from Dorset to Sutherland, Scotland. The ornamentation in P. batei is of much stronger pitting, the pits being of fairly uniform size, and it is a much larger ostracod than P. confossa having a length of .70 mm for females and .77 for males (compared with .55 and .60 respectively for P. confossa). The two species have, however, the same basic shape, internal details and pronounced dimorphism, suggesting that P. confossa gave rise to P. batei, either at the close of the Bathonian Stage or at the beginning of the Callovian i.e. during deposition of the Cornbrash. The larger species, P. batei was then able to inhabit the much wider geographical area produced by the extensive marine transgression that occurred at that time.

Although P. confossa has a reasonably long vertical range it is most prolific in the Fuller's Earth Rock of southern England and in the topmost beds of the underlying L. Fuller's Earth (both occurring within the confossa Zone). It remains a common faunal element within sediments of the polonica Zone but is rare within sediments of blakeana and falcata Zone, apparently disappearing finally in the Forest Marble.

Genus Schuleridea Swartz & Swain, 1946.

Subgenus Eoschuleridea Bate, 1967.

REMARKS. This subgenus was erected to accommodate those species of Schuleridea having a reduced number of marginal pore canals; 18 - 30 anterior canals as opposed to 30 - 60 for Schuleridea s.s. Eoschuleridea has been shown by Bate (1967) to be both morphologically and stratigraphically between Praeschuleridea and Schuleridea, this representing an evolutionary sequence from Praeschuleridea in the Bajocian with few marginal pore canals, through Eoschuleridea in the Bathonian, to Schuleridea in the U. Jurassic and Cretaceous with many canals. There is also an accompanying development of an eye node.

Schuleridea (Eoschuleridea) bathonica Bate, 1967

(Pl. 27, fig. 7)

1967 Schuleridea (Eoschuleridea) bathonica Bate, 41, pl. 7, figs. 7 - 13; pl. 8, figs. 1 - 11.

1978 Schuleridea (Eoschuleridea) bathonica Bate, 244, pl. 10, figs. 7 - 10.

DIAGNOSIS. Carapace subovate in side view, tapering to posterior. Dorsal margin arched, left valve more strongly umbonate in male dimorph. Shell surface punctate.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Bate, 1967.

DISTRIBUTION. Recorded previously from the U. Bathonian U. Estuarine Series (polonica and blakeana Zones) of eastern England. It is here recorded from all 3 sampling provinces: U. Bathonian Frome Clay (blakeana Zone) of Dorset, U. Bathonian Forest Marble and equivalent beds of the Kent-Boulonnais Province and U. Bathonian Blainville and Ranville Members (polonica and blakeana Zones) of Normandy.

ECOLOGY. A shallow water marine species, occurring close to land.

REMARKS. This species is similar in shape and dimensions to S. (E) batei Dépêche and possesses a surface punctation which is fully developed as large pits in the latter species. This morphological similarity and the stratigraphic positioning of the two species suggests that S. (E.) batei could be ancestral to S. (E.) bathonica with the evolution of S. (E.) bathonica occurring sometime during the M. Bathonian confossa Zone in Normandy and at the same time or slightly later in Dorset (see Table 5 -15). It is evident, too, that S. (E.) bathonica had a preference for a shallower water environment than that of S. (E.) batei, inhabiting the littoral to sublittoral regions of carbonate deposition in Normandy and the shoreline areas of Kent-Boulonnais; in both these regions S. (E.) batei is absent. Within the Dorset Province the two species show a slight overlap in their vertical ranges but with the onset of Forest Marble deposition S. (E.) batei finally dies out and is replaced by S. (E.) bathonica.

Schuleridea (Eoschuleridea) batei Dépêche, 1973

(Pl. 27, figs. 8 - 12)

1973 Schuleridea (Eoschuleridea) batei Dépêche, 220, pl. 2, figs. 1 - 8.

DIAGNOSIS. Carapace subtrigonal in side view in female dimorph; elongate oval in male. Shell surface pitted, pits increasing in size towards valve centre. Eye swelling prominent.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Dépêche, 1973.

DISTRIBUTION. Previously recorded by Dépêche from the L. Bathonian Marnes de Port-en-Bessin, Normandy and by Bate & Sheppard (1981) from the L. Bathonian L. Fuller's Earth of the Winterborne-Kingston borehole, Dorset. Within the study area the species occurs within the L. Fuller's Earth to Frome Clay (rimosa to blakeana Zones) of the Dorset Province and within the Marnes de Port-en-Bessin (rimosa Zone) of the Normandy Province.

ECOLOGY. A marine species, favouring an offshore environment.

REMARKS. The constant first appearance of this species within the L. Bathonian sediments of rimosa Zone age have enabled it to be of use as index species for the batei Subzone, identifiable in Dorset and Normandy. The species in Normandy, however, does not occur in sediments younger than L. Bathonian whereas in Dorset it persists through into sediments of U. Bathonian age (blakeana Zone). It is possible that the relatively sudden shallowing of the sea that occurred in the Normandy area from the M. Bathonian 'Calcaire de Caen' period onwards with extensive carbonate deposition was the cause of its disappearance. Although shallowing was occurring also in Dorset at this time it was rather more gradual with the extensive carbonate deposits mainly to the north east of the area. The species was consequently able to flourish (it is often found as a major element of the fauna in the subsurface material) until the rapid shallowing of the sea that accompanied deposition of the Forest Marble.

Schuleridea (Eoschuleridea) trigonalis (Jones, 1884)
(Pl. 28, figs. 1, 2)

1884 Bairdia trigonalis Jones, 767, pl. 34, fig. 19

1969 Schuleridea (Eoschuleridea) trigonalis (Jones); Bate, 386, pl. 2, fig. 7.

1978 Schuleridea (Eoschuleridea) trigonalis (Jones); Bate, 244, pl. 10, figs. 11, 12.

DIAGNOSIS. Carapace trigonal in lateral outline with straight dorsal margin sloping steeply down from umbonate anterior cardinal angle to posterior end of valve.

MATERIAL. 47 valves and carapaces.

DESCRIPTION. See Bate, 1969.

DISTRIBUTION. Apart from the type level and locality of U. Bathonian Great Oolite of the Richmond boring, Surrey, this species has been further recorded from the U. Bathonian U. Fuller's Earth (blakeana Zone) of the Bath area (Bate, 1978) and the Forest Marble (falcata Zone) in subsurface material of Dorset (Bate & Sheppard, 1981). In the study area it occurs within the Dorset Province: the U. Bathonian Forest Marble (falcata Zone), and the Kent-Boulonnais Province: the Forest Marble and equivalent beds of the subsurface and outcrop material respectively.

ECOLOGY. A shallow water marine species, occupying littoral to neritic environments.

REMARKS. The characteristic trigonal lateral outline of this species makes it distinct from all other species of Schuleridea and Eoschuleridea.

Schuleridea (Eoschuleridea) sp.

(Pl. 28. fig. 3).

1979 Schuleridea (Eoschuleridea) sp. Bate, fig. 5.

REMARKS. Seven specimens of an as yet unnamed and unfigured species of Eoschuleridea were recovered from the U. Bathonian Frome Clay (blakeana Zone) of the Seabarn Farm borehole, Dorset and from the Forest Marble (blakeana and falcata Zones) of the Brabourne and Calvert boreholes, Kent-Boulonnais Province. The species is recognised by its sharply angled posterior cardinal angle and steeply sloping posterodorsal slope which is either straight or concave. It was first recognised in the Horsecombe Vale borehole, Bath, ranging from L. Bathonian L. Fuller's Earth (rimosa Zone) to U. Bathonian U. Fuller's Earth by Bate (1979) and has since been recorded by Stephens (1980) from the U. Bathonian White Limestone (falcata Zone) of Oxfordshire. The specimens occurring within the study area are not particularly well preserved and it was considered best not to name and describe the species fully on these specimens; rather, at a later date, the species can be named using primarily the Bath material.

Genus Eudechacythere Dépêche & Guyader, 1970

Eudechacythere batei sp. nov.

(Pl. 28, figs. 4 - 6; text-fig. 5 - 7).

1979 Eudechacythere sp. Bate, fig. 5.

Explanation of Plate 28

Figs. 1, 2. Schuleridea (Eoschuleridea) trigonalis (Jones): fig. 1, ♀ LV, OS 11856 (.66 mm long, x 90), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-Bo.4.79); fig. 2, ♀ car., L side, OS 11855 (.65 mm long, x 92), U. Bathonian, as above.

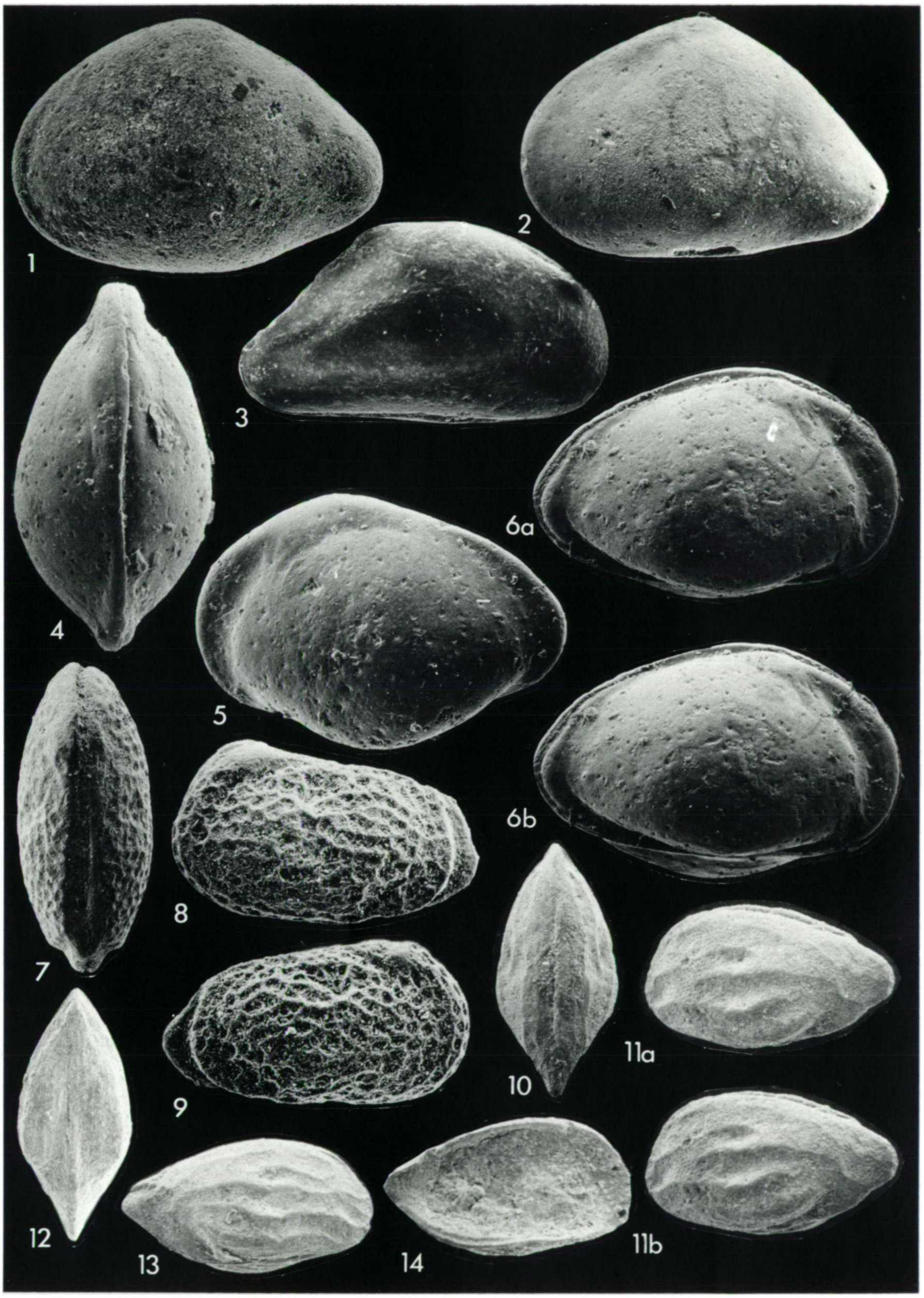
Fig. 3. Schuleridea (Eoschuleridea) sp., car., R side, MPA 5461-C2 (.63 mm long, x 95), U. Bathonian, Frome Clay, depth 105.00 m, Seabarn Farm borehole.

Figs. 4 - 6. Eudechacythere batei sp. nov.: fig. 4, car., dors., MPA 5590-C2 (.44 mm long, x 139); fig. 5, car., L side, MPA 5590-C3 (.43 mm long, x 142); fig. 6, stereo-pair of holotype, car., R side, MPA 5590-C1 (.46 mm long, x 139). All U. Bathonian, U. Fuller's Earth, depth 170.66 m, Seabarn Farm borehole.

Figs. 7 - 9. Parariscus bathonicus Oertli: fig. 7, ♀ dors., MPA 4786-C1 (.31 mm long, x 161), U. Bathonian, Forest Marble, depth 53.00 m, Seabarn Farm borehole; fig. 8, ♀ LV, OS 11862 (.38 mm long, x 131), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO.3.79); fig. 9, ♀ RV, OS 11861 (.39 mm long, x 128), U. Bathonian, as above.

Figs. 10 - 14. Procytherura trisulcata sp. nov.: fig. 10, car., dors., OS 11865 (.28 mm long, x 142), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.7.78); fig. 11, stereo-pair of holotype, car., L side, OS 11863 (.27 mm long, x 148), L. Bathonian, as above (F-PB.11.78); fig. 12, car., vent., OS 11866 (.27 mm long, x 148), L. Bathonian, as above (F-PB.7.78); fig. 13, car., R side, OS 11864 (.27 mm long, x 148), L. Bathonian, as above (F-PB.11.78); fig. 14, LV int., OS 11867 (.27 mm long, x 148), L. Bathonian, as above (F-PB.7.78).

PLATE 28



DERIVATION OF NAME. In honour of Dr. Ray Bate.

DIAGNOSIS. Oval carapace with rounded anterior margin, blunt posterior margin; ventrolateral overhang of valves. Distinct eye swelling with shallow groove behind; shell surface smooth. Amphidont hinge.

MATERIAL. 10 carapaces, 3 valves.

HOLOTYPE. Carapace, MPA 5590-C1, basal Frome Clay, U. Bathonian polonica Zone, Seabarn Farm borehole, depth 170.66 m, Dorset.

DESCRIPTION. Oval carapace with rounded anterior margin, blunt triangular posterior margin; both margins well compressed. Dorsal margin straight, sloping to posterior with rounded but distinct cardinal angles. Ventral margin slightly convex with pronounced mid-valve concavity. Both valves overhang ventral margin mid-ventrally. Line of greatest length of carapace passes just below mid point, greatest height passes through anterior cardinal angle, greatest width in posterior third. Shallow but distinct eye swelling at anterodorsal corner with short groove just behind. Shell surface smooth with small, irregularly scattered and deeply set, normal pore canal openings. LV larger than RV which it overreaches on all sides, more strongly so along dorsal edge and overlaps along ventral margin.

Inner margin and line of concrescence coincide producing a moderately wide duplicature. Marginal pore canals straight, approximately 14 anteriorly, 7 posteriorly (see fig. 5 - 7). Hinge amphidont with, in LV, terminal loculate sockets and a smooth median bar with knob-like swelling anteriorly; distinct accommodation groove above median bar. Muscle scars not observed. Carapace non-dimorphic.

DISTRIBUTION. As Eudechacythere sp., this species has only been previously recorded from the U. Bathonian U. Fuller's Earth (polonica to blakeana Zones) of the Horsecombe Vale borehole in the Bath area (Bate, 1979). In the study area it occurs in the Dorset Province only, from the U. Bathonian lower part of the U. Fuller's Earth (polonica Zone).

DIMENSIONS.

			L	H	W	Depth (m)
holotype,	car.,	MPA 5590-C1	.46	.28	.23	170.66
paratypes:	car.,	MPA 5590-C2	.44	.28	.24	"
	car.,	MPA 5590-C3	.43	.26	.23	"

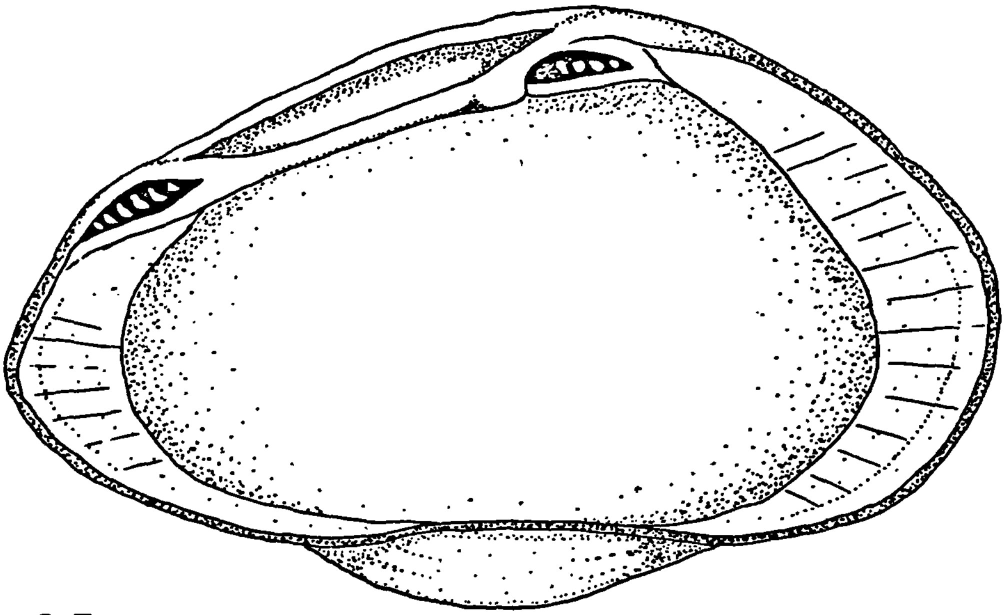


Figure 5-7

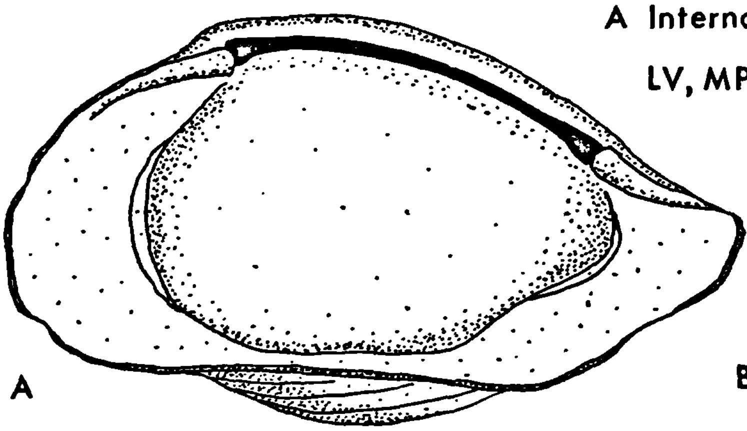
Internal details of *Eudechacythere batei* sp. nov.

LV, MPA 5590-C1, X 282

Figure 5-8 *Procytherura trisulcata* sp. nov.

A Internal details of

LV, MPA 6479-C2, X285

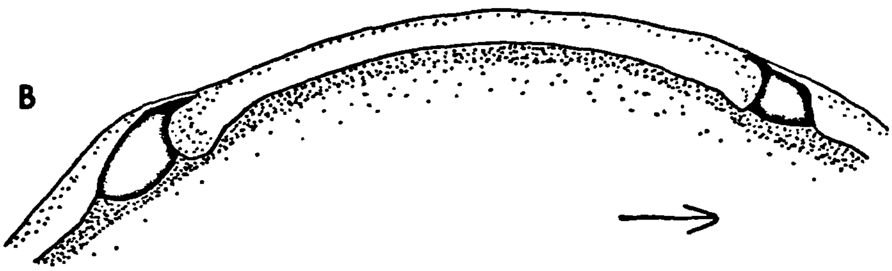


A

B Hinge of RV,

OS 11867, X420

B



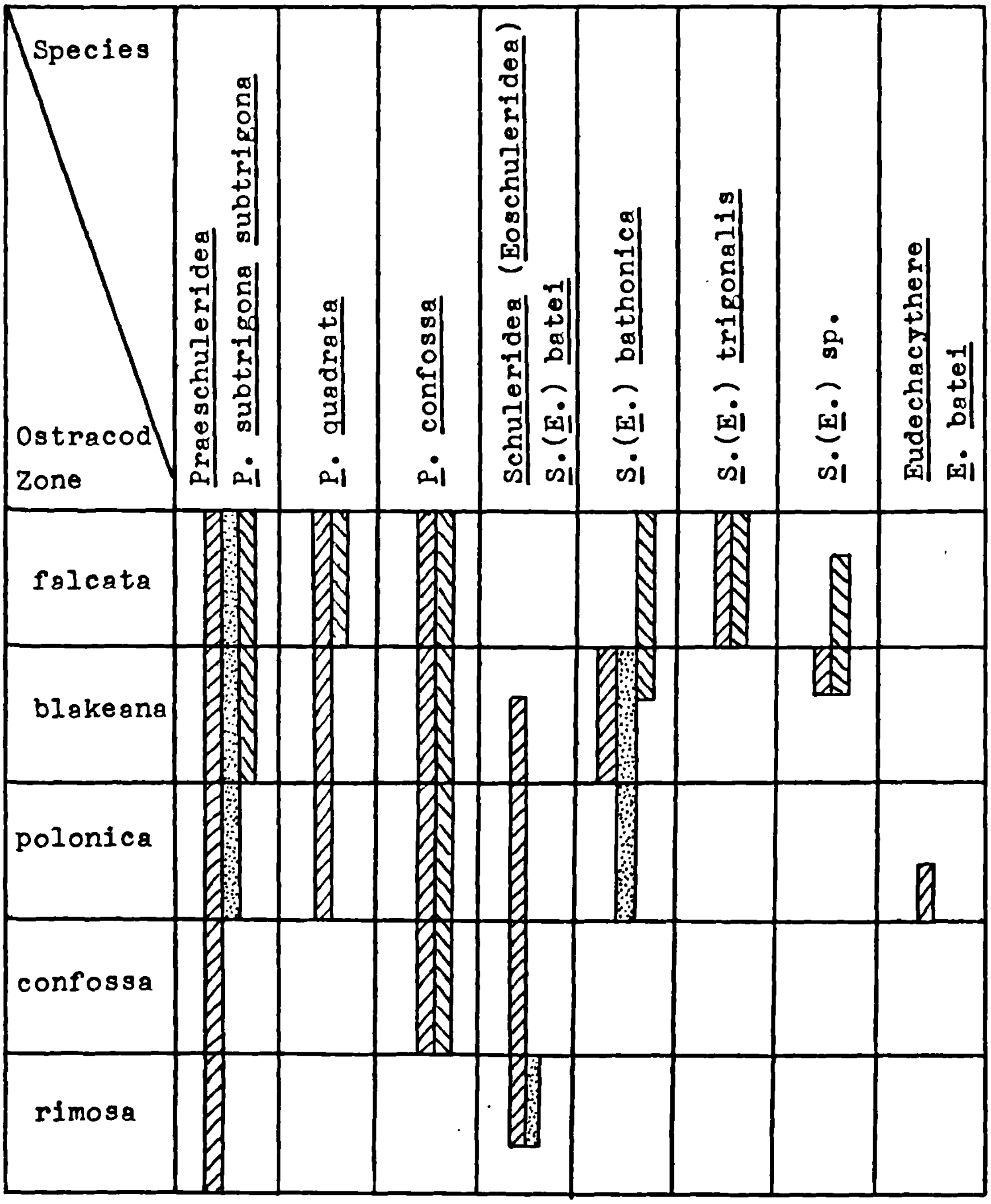


Table 5-15 Range table for the Schulerideidae.

		L	H	W	Depth (m)
LV,	MPA 5590-C4	.50	.29		170.66
car.,	MPA 5588-C2	.46	.28	.25	169.05
LV,	MPA 5588-C3	.48	.29		"

ECOLOGY. An inhabitant of a relatively low energy shelf environment, found within clay-based sediments.

REMARKS. This is only the second known species of the genus. E. puncticava Depêche & Guyader, 1970 (on which the genus was erected) from the Callovian of Lorraine and Normandy, is distinct both in shape and ornament. In E. puncticava the posterodorsal and posteroventral margins taper markedly to a point whereas in E. batei the posterior margin is more rounded and blunt. In the RV of E. puncticava the dorsal margin is medially arched so that the greatest height in this valve passes through the mid-point. In the LV, however, as in both valves of E. batei, the highest point coincides with the anterior cardinal angle. Ornamentation in E. puncticava is present only in the Lorraine material and comprises a fine reticulate network of small raised bead-like structures. The Normandy material, according to Dépêche & Guyader, is smooth but is nevertheless quite distinct from E. batei on the aspects of shape mentioned above. In all other respects the two species are alike. In size they are almost identical, E. puncticava having a length range of .44 - .50 mm and height range of .26 - .28 mm. From this evidence it would seem logical to conclude that E. batei is ancestral to E. puncticava although precisely when the evolution took place is unknown owing to the restricted stratigraphical and geographical occurrence of the two species.

Family CYTHERURIDAE Müller, 1894

Subfamily CYTHERURINAE Müller, 1894

Genus Parariscus Oertli, 1959

Parariscus bathonicus Oertli, 1959

(Pl. 28, figs. 7 - 9)

1959 Parariscus bathonicus Oertli, 118, pl. 2, figs. 20 - 29.

1979 Parariscus bathonicus Oertli; Bate, fig. 5.

DIAGNOSIS. Carapace rectangular in female dimorph; elongate in male. Anterior margin rounded, posterior acuminate with caudal process. Eye node distinct. Shell surface reticulate. Few, widely spaced, straight marginal pore canals.

MATERIAL. Over 100 valves and carapaces.

DESCRIPTION. See Oertli, 1959.

DISTRIBUTION. Originally described from the U. Bathonian of "Les Pichottes" Quarry, Boulogne and further recorded from the U. Fuller's Earth (blakeana Zone) of the Horsecombe Vale Borehole, Bath (Bate, 1979) and the Forest Marble (falcata Zone) of Oxfordshire (Ware & Whatley, 1980). In the study area it is a common ostracod occurring within the Frome Clay to Forest Marble (polonica to falcata Zones) of several borehole sequences in the Dorset Province and the Forest Marble and equivalent (falcata Zone) of the Kent-Boulonnais Province.

ECOLOGY. A ubiquitous species occupying littoral to sublittoral shelf environments, clay and carbonate facies.

REMARKS. P. bathonicus is a typical U. Bathonian marine ostracod, a common faunal element in southern England and Boulonnais but absent in Normandy. P. octoporalis Blaszyk, 1967 is externally very similar to P. bathonicus but internally has only 5 anterior marginal canals as opposed to the 8 of P. bathonicus, the middle 2 commonly expanded anteriorly. P. octoporalis occurs in U. Bajocian sediments of Poland and the Ukraine, the similarity in ornament suggesting that the species might be ancestral to P. bathonicus.

Genus Procytherura Whatley, 1970, emend
Bate & Coleman, 1975

Procytherura trisulcata sp. nov.

(Pl. 28, figs. 10 - 14; pl. 29, figs. 1, 2; text-fig. 5 - 8)

DERIVATION OF NAME. Latin tri, three plus sulcata, furrow.

DIAGNOSIS. Oval carapace with three main longitudinal furrows. Shell surface finely punctate. Indistinct eye spot.

Explanation of Plate 29

Figs. 1, 2. Procytherura trisulcata sp. nov., car., MPA 6479-C1 (.28 mm long): fig. 1, detail of surface punctation (x 710); fig. 2, R side (x 142), L. Bathonian, L. Fuller's Earth, depth 365.00 m, Seabarn Farm borehole.

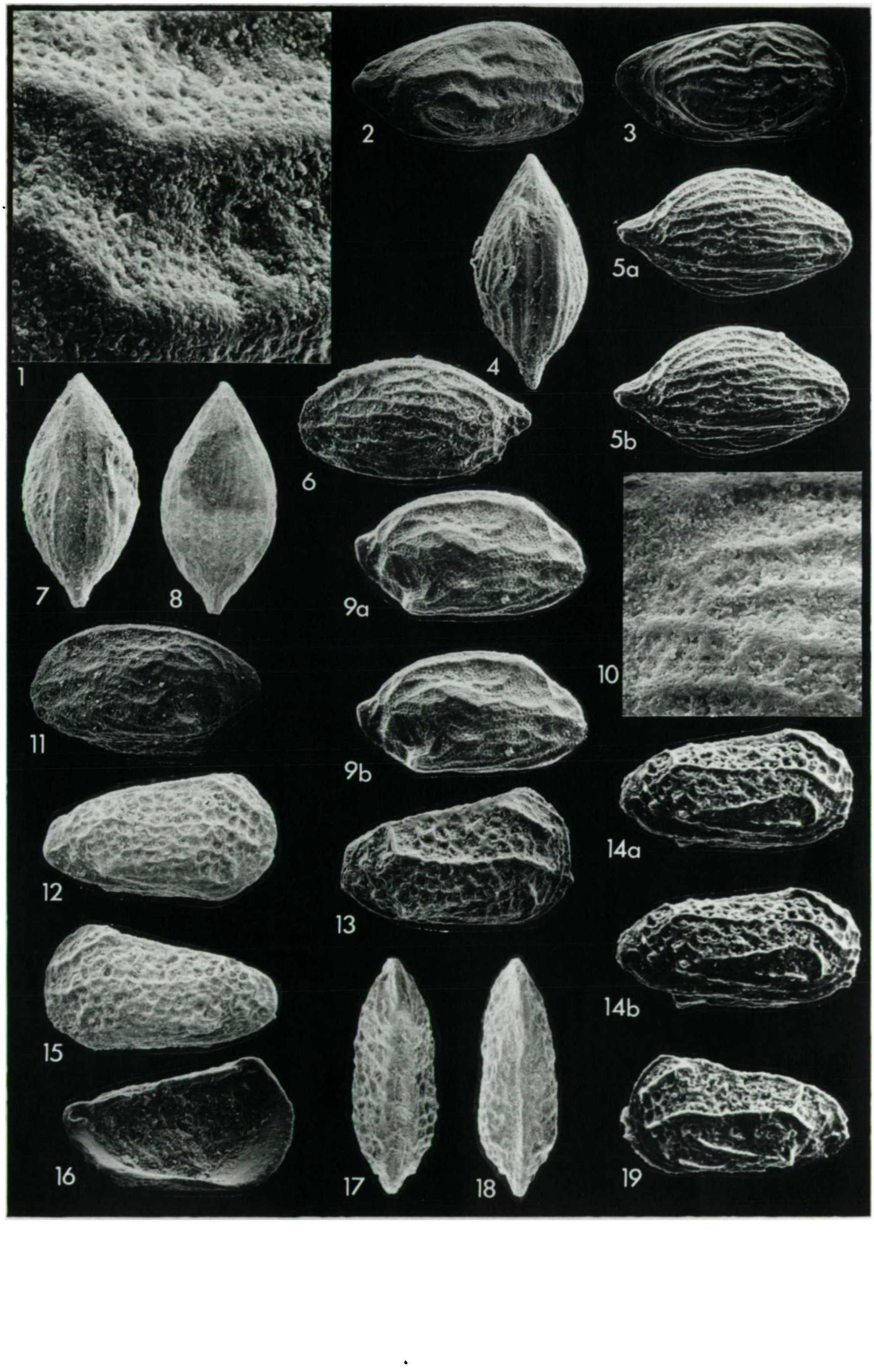
Fig. 3. Procytherura sp., car., R side, MPA 6218-C1 (.31 mm long, x 127), L. Bathonian, as above, depth 321.00 m.

Figs. 4 - 6, 10. Hemicytherura ? testudinata sp. nov.: figs. 4, 5, holotype, car., OS 11872 (.30 mm long, x 129): fig. 4, dors.; fig. 5, stereo-pair of R side, L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.36.78); figs. 6, 10, LV, OS 11873 (.29 mm long); fig. 6, ext. lat. (x 137); fig. 10, detail of ornament (x 1K), L. Bathonian, Marnes de Port-en-Bessin, Arromanches (F-A.4.78).

Figs. 7 - 9, 11 Hemicytherura ? bessinensis sp. nov.: figs. 7, 8, 11, car., OS 11870 (.28 mm long, x 142): fig. 7, dors.; fig. 8, vent.; fig. 11, L side, L. Bathonian, as above (F-PB.46.78); fig. 9, stereo-pair of holotype, RV, OS 11869 (.27 mm long, x 148), L. Bathonian, as above (F-PB.40.78).

Figs. 12 - 19. Tethysia bathonica sp. nov.: fig. 12, car., R side, OS 11877 (.28 mm long, x 142), L. Bathonian, as above (F-PB.11.78); figs. 13, 17, car., OS 11878 (.29 mm long, x 137): fig. 13, R side; fig. 17, dors., L. Bathonian, as above; fig. 14, stereo-pair of holotype, car., R side, OS 11875 (.28 mm long, x 142), L. Bathonian, as above (F-PB.5.78); fig. 15, car., L side, OS 11876 (.28 mm long, x 142), L. Bathonian, as above (F-PB.11.78); fig. 16, LV int., OS 11881 (.26 mm long, x 153), L. Bathonian, as above; fig. 18, car., vent., OS 11879 (.29 mm long, x 137), L. Bathonian, as above; fig. 19, LV, OS 11880 (.29 mm long, x 137), L. Bathonian, as above (F-PB.5.78).

PLATE 29



MATERIAL. 15 valves and carapaces.

HOLOTYPE. Carapace, OS 11863, L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.

DESCRIPTION. Oval carapace with rounded anterior margin, acuminate posterior margin. Dorsal margin slightly convex, ventral margin convex with median concavity. Line of greatest length of carapace passes through mid-point, greatest height in anterior third, greatest width in posterior third. Carapace moderately swollen with shallow dorsomedian sulcus and slight ventrolateral overhang of valves. Surface sculpturing consists of 3 main longitudinal furrows in LV; 4 in RV with irregular ridges in between extending forwards to anterior margin but terminating a short distance from posterior margin. Shell surface finely, evenly punctate. RV slightly larger than LV which it overlaps along dorsal margin.

Hinge holoperatodont (Bate, 1972) with smooth elements comprising, in LV, median bar expanded anteriorly and posteriorly and simple terminal sockets. Duplicature wide with shallow vestibules produced anteriorly and posteriorly (see fig. 5 - 8). Marginal pore canals and muscle scars not visible. Dimorphism not observed.

DISTRIBUTION. In the study area the species occurs in the L. Bathonian, basal L. Fuller's Earth of the Dorset Province and the L. Bathonian Marnes de Port-en-Bessin of the Normandy Province. It occurs also within the L. Fuller's Earth of the Horsecombe Vale borehole, Bath (personal examination of the material).

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11863	.27	.14	.13	F-BB.11.78
paratypes:	car.,	OS 11864	.27	.14	.13	"
	car.,	OS 11865	.28	.15	.13	F-PB.7.78
	car.,	OS 11866	.27	.15	.13	"
	LV,	OS 11867	.27	.14		"
	car.,	MPA 6479-C1	.28	.14	.13	Seabarn Farm 365.00 m
	RV,	MPA 6479-C2	.28	.16		"

ECOLOGY. A marine species inhabiting a low energy environment as evidenced by the fine-grained clay deposits in which it occurs.

REMARKS. This is a particularly small species of the genus, previously described species having an approximate length of .36 mm. It is distinguished from all others by having a relatively simple surface ornamentation, in contrast with the coarse ridges and reticulation of P. hastata and P. mediocostata both Bate & Coleman, 1975 from the Lias of central England and the numerous, though weak transverse ridges of P. tenuicostata Whatley, 1970 from the Oxfordian of England and Scotland.

Though a rare member of the fauna, P. trisulcata is a useful marker of basal Bathonian age in Dorset and Normandy.

Procytherura sp. 1.

(Pl. 29, fig. 3)

REMARKS. A single specimen belonging to the genus Procytherura found at a depth of 321.00 m, Seabarn Farm borehole, Dorset, within the lower part of the L. Fuller's Earth. This is larger than P. trisulcata, having a length of .31 mm, and is ornamented by numerous transverse ridges, similar to P. tenuicostata Whatley, 1970 but differing by having both anterior and posterior margins compressed (in P. tenuicostata the posterior margin only is compressed). A specific name has not, however, been assigned at this stage.

Genus Hemicytherura Elofson, 1941

Hemicytherura? testudinata sp. nov.

(Pl. 29, figs. 4 - 6, 10)

DERIVATION OF NAME. Latin, meaning arched like a tortoise shell, referring to the dorsal outline.

DIAGNOSIS. Oval carapace with broadly convex dorsal and ventral outlines, pointed posterior termination. Shell surface coarsely pitted with superimposed reticulation of longitudinal ribs with short cross-connections.

MATERIAL. 3 carapaces and 1 valve.

HOLOTYPE. Carapace, OS 11872, L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.

DESCRIPTION. Oval carapace with rounded anterior margin, broadly convex dorsal margin and ventral outline; ventral margin convex with slight median concavity. Posterior margin narrow, acuminate. Lines of greatest length, height and width pass through mid point of carapace. RV larger than LV which it overreaches along dorsal margin. Ventrolateral part of valves slightly overhangs ventral margin. Shell surface strongly pitted with a secondary reticulation of ribs as diagnosed. Smooth, indistinct eye spot.

Hinge holoperatodont with, in LV, terminal sockets separated by a smooth convex median bar expanded anteriorly and posteriorly. Duplicature wide; inner margin and line of concrescence coincident. Muscle scars and pore canals not observed.

DISTRIBUTION. Found only within the L. Bathonian Marnes de Port-en-Bessin of Bessin and Arromanches, Normandy.

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11872	.30	.17	.14	F-PB.36.78
paratype,	LV,	OS 11873	.29	.17		F-A.4.78

ECOLOGY. Shallow water marine shelf environment.

REMARKS. H. ? testudinate bears close resemblances to 2 previously described Jurassic species; H.? sp. of Oertli, 1972 from presumed U. Jurassic sediments of the western Atlantic, and Procytherura ? delicatula Pokorny, 1973 from the presumed Tithonian of Czechoslovakia. In H. ? sp. the dorsal margin is more steeply arched but the ornamentation is almost identical to that of H. ? testudinata. In P. ? delicatula the shape and overlap details are as for H. ? testudinata but the ornamentation comprises pitting and longitudinal ribs only; the short cross-ribs are lacking. The Bathonian material presented here is possibly ancestral to both these species, with relatively minor morphological variations accompanying westerly and easterly movement. Without internal details of the latter 2 species, however, and with the absence of further similar species in the Jurassic the evidence for this relationship becomes somewhat scanty and subjective.

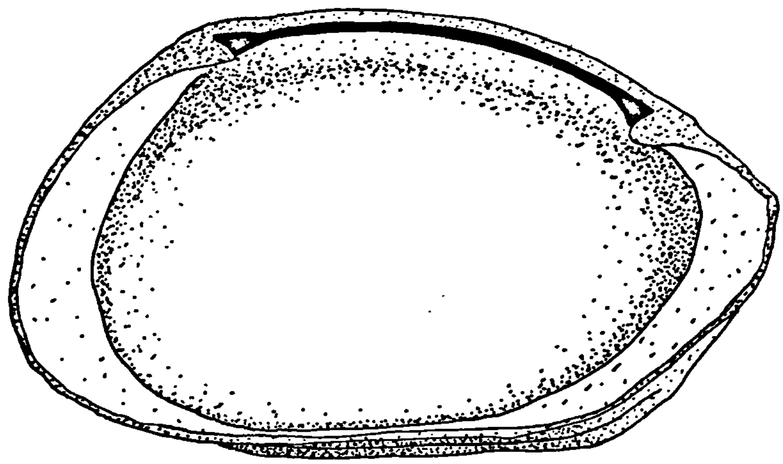
The generic assignment is uncertain owing to a) the lack of material showing good internal features, b) the ventral outline is rather too evenly convex rather than essentially straight with a distinct posteroventral convexity, and c) Hemicytherura is currently an U. Cretaceous to Recent genus. The species is not considered a Procytherura because the carapace is too uniformly rounded rather than elongate and the shallow dorsomedian sulcus of Procytherura is lacking.

Hemicytherura ? bessinensis sp. nov.
(Pl. 29, figs. 7 - 9, 11; text-fig. 5 - 9)

DERIVATION OF NAME. Referring to the type locality, Port-en-Bessin.
DIAGNOSIS. Carapace oval to subquadrate with arched dorsal margin and straight ventral margin with short posteroventral projection of valve causing angularity. Shallow but distinct furrow in dorsal half of shell, paralleling dorsal margin. Shell surface strongly pitted with an additional faint reticulation.
MATERIAL. 3 valves, 3 carapaces.
HOLOTYPE. Right valve, OS 11869, L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.
DESCRIPTION. Oval to subquadrate carapace with convex dorsal margin, rounded anterior margin and straight ventral margin. Posterior margin narrow, acuminate. Lines of greatest length, height and width pass through mid-point of carapace. RV larger than LV which it overreaches dorsally. Posteroventral part of valve overhangs ventral margin as a short projection, above which is a shallow crescentic concavity. A further furrow occurs in dorsal half of shell, paralleling dorsal margin. Shell surface strongly pitted, with an additional faint reticulation of shallow ribs. A prominent rib is situated along dorsal edge of dorsal furrow while several parallel ribs run longitudinally along ventral surface. Eye spot smooth. Carapace dimorphic with males proportionally longer and narrower than females.

Inner margin and line of concrescence coincide producing a duplicature of moderate width. Hinge holoperatodont with, in RV, smooth terminal teeth separated by a smooth median groove expanded anteriorly and posteriorly (fig. 5 - 9). Muscle scars and pore canals not observed.

Figure 5-9 Hemicytherura? bessinensis sp.nov.
RV internal, holotype OS 11869 X 370



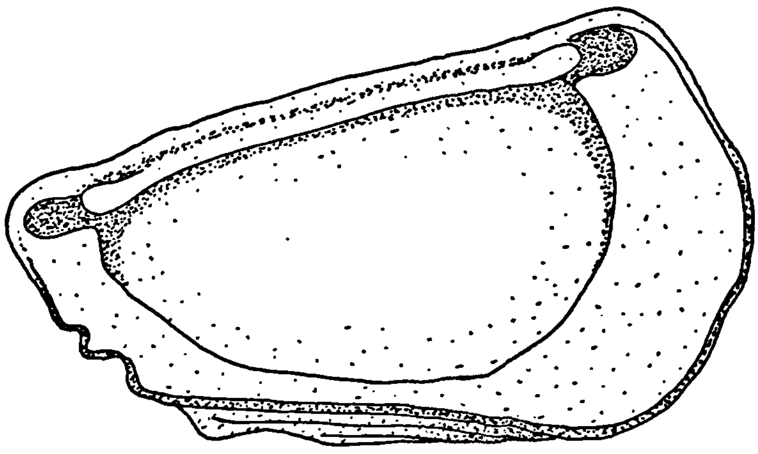


Figure 5-10
Tethysia bathonica sp.nov.
LV internal, OS 11880
X 284

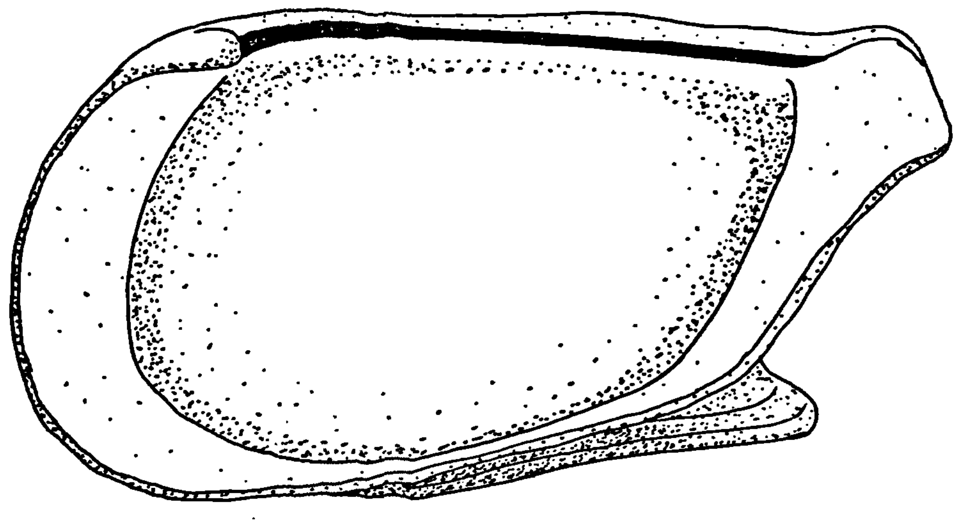


Figure 5-11 Paracytheridea? elegans sp.nov.
RV internal, OS 11909 X378

DISTRIBUTION. Found only within the L. Bathonian Marnes de Port-en-Bessin at Bessin, Normandy.

DIMENSIONS.

			L	H	W	Locality
holotype,	♀ RV,	OS 11869	.27	.16		F-PB.40.78
paratypes:	♀car.,	OS 11870	.28	.16	.14	F-PB.46.78
	♀ RV,	OS 11871	.29	.17		F-PB.39.78
	♂car.,	OS 11874	.29	.16	.12	F-PB.45.78

ECOLOGY. Shallow water marine, occurring within a fine grained clay/marl sediment indicative of a relatively low energy environment.

REMARKS. The generic assignment of this species, as with H. testudinata sp. nov., is queried due mainly to the lack of well preserved internal features, although the shape is more typical of Hemicytherura. There appear to be no similar described species in the Mesozoic with which to make comparisons.

Genus Tethysia Donze, 1975

REMARKS. As its name suggests, this genus was originally described from deposits of U. Jurassic and L. Cretaceous age, from those areas considered to have bordered the deep-water region of the Tethys; southern France and northern Tunisia. Those forms described by Donze are more than likely to be deep water forms but in considering the phylogenetic history of the genus, Donze states that it may well be derived from shallower water, sublittoral, stock. The Bathonian material described here is sufficiently similar in external morphology to represent this ancestral stock.

Tethysia is very similar to Rutlandella Bate & Coleman, erected in the same year from the Lias of central England. The major difference between the two is the possession of a prominent eye node in the latter which is considered by Bate & Coleman to be sufficiently important to merit the erection of their new subfamily Oculocytheropterinae.

Donze regarded Tethysia as possibly belonging to the subfamily Trachyleberidinae of the family Cytheridae. It would seem to be better accommodated, however, within the subfamily Cytherurinae of the family Cytheruridae.

Tethysia bathonica sp. nov.

(Pl. 29, figs. 12 - 19; pl. 30, figs. 1, 2; text-fig. 5 - 10)

1981 Rutlandella sp. cf. R. transversiplicata Bate & Coleman; Sheppard, in press.

DERIVATION OF NAME. After the Bathonian Stage in which this species is found.

DIAGNOSIS. Tethysia with median rib extending from just behind anterior margin to posterior region where it divides, one branch extending up to posterior cardinal angle, the other directed posteroventrally. A short rib extends obliquely down from anterior cardinal angle to just above mid-point on anterior margin. A further rib, variously developed, situated below median rib extending down to posteroventral region; a short fourth rib may or may not be present below this in anteroventral region. Intercostate areas reticulate.

MATERIAL. Over 100 valves and carapaces.

HOLOTYPE. Carapace, OS 11875, L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.

DESCRIPTION. Elongate carapace with rounded anterior margin, narrowly rounded posterior margin and straight dorsal and ventral margins. Carapace longest medially, highest in anterior third and widest in posterior third. Anterior and posterior margins slightly compressed. Surface ornament as for diagnosis; reticulation produced by large subrounded pits. Eye nodes absent. LV slightly larger than RV which it overlaps midventrally and overreaches along posterodorsal slope. Carapace non dimorphic.

Internally inner margin and line of concrescence coincide producing a wide duplicature (fig. 5 - 10). Hinge holoperatodont with, in LV, median smooth bar expanded at either end and terminal smooth sockets. Muscle scars and pore canals not observed.

DISTRIBUTION. This species occurs within the L. Bathonian Marnes de Port-en-Bessin of the Normandy Province and the L. to U. Bathonian, L.

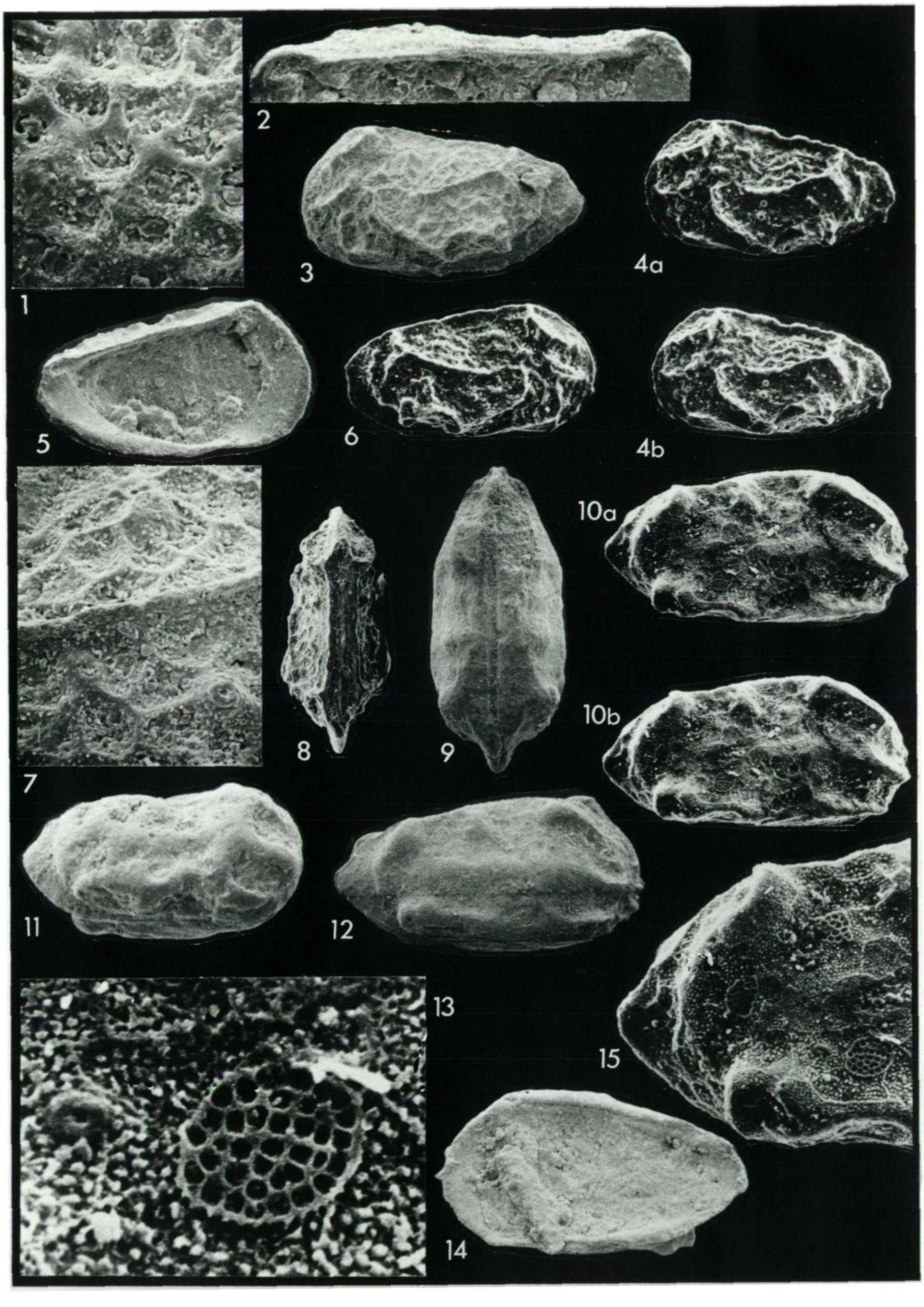
Explanation of Plate 30

Figs. 1, 2. Tethysia bathonica sp. nov.: fig. 1, detail of ornament (x 1.5K) from OS 11876; fig. 2, hinge (x 170) of OS 11881. Both L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.11.78).

Figs. 3 - 8. Tethysia irregularis sp. nov.: figs. 3, 7, 8, car., OS 11884 (.34 mm long): fig. 3, L side (x 117); fig. 7, detail of ornament (x 1K); fig. 8, dors. (x 117), L. Bathonian, as above (F-PB.4.78); figs. 4, 5, holotype, LV, OS 11882 (.34 mm long, x 117): fig. 4, stereo-pair of ext. lat.; fig. 5, int. lat., L. Bathonian, as above (F-PB.5.78); fig. 6, RV, OS 11883, (.32 mm long, x 125), L. Bathonian, as above.

Figs. 9 - 15. Rutlandella enigmatica sp. nov.: fig. 9, car., dors., OS 11890 (.34 mm long, x 147), L. Bathonian, Marnes de Port-en-Bessin, Arromanches (F-A.3.78); figs. 10, 13, 15, holotype, RV, OS 11888 (.34 mm long): fig. 10, stereo-pair of ext. lat. (x 147); fig. 13, detail of "empreinte enigmatique" (x 1K); fig. 15, detail of posterior part (x 250), L. Bathonian, as above, Port-en-Bessin (F-PB.40.78); fig. 11, juv. car., R side, OS 11895 (.21 mm long, x 238), L. Bathonian, as above (F-PB.52.78); fig. 12, car., R side, OS 11889 (.34 mm long, x 147), L. Bathonian, as above, Arromanches (F-A.3.78); fig. 14, RV int., OS 11892 (.32 mm long, x 156), L. Bathonian, as above, Port-en-Bessin (F-PB.48.78).

PLATE 30



Fuller's Earth to basal Frome Clay (rimosa to polonica Zones) of the Dorset Province.

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11875	.28	.15	.12	F-PB.5.78
paratypes:	car.,	OS 11876	.28	.15	.11	F-PB.11.78
	car.,	OS 11877	.28	.15	.11	"
	car.,	OS 11878	.29	.15	.10	"
	car.,	OS 11879	.29	.16	.10	"
	LV,	OS 11880	.29	.16		F-PB.5.78
	LV,	OS 11881	.26	.11		F-PB.3.78

ECOLOGY. Marine, shallow water offshore shelf environment, occurring within fine-grained clay-type sediments.

REMARKS. T. bathonica closely resembles T. chabrensis Donze, 1975, from the U. Jurassic/L. Cretaceous of southern France and northern Tunisia. The distinguishing feature of T. chabrensis is the presence of a peripheral anterior marginal rib which is a continuation of the anterodorsal rib in T. bathonica. In all other respects the two species are identical which is of interest considering the age difference and the vastly different locality and environmental conditions. As previously mentioned Donze would regard a shallow water ancestor to his material to be a possibility. T. bathonica is so close in morphology to T. chabrensis that it is natural to conclude that this is ancestral to the latter. T. bathonica appears to die out in the study area fairly early on in the U. Bathonian (polonica Zone). A southerly dispersal through France and ultimately to the region occupied by the Tethys is implied but this has yet to be tested by the examination of M. and U. Jurassic sediments in central and southern France.

The similarity of Tethysia to Rutlandella has already been noted and, as can be seen in the synonymy, T. bathonica has previously been mistakenly assigned to that genus, a direct comparison being made with R. transversiplicata. The two species are very similar in shape and surface features, differing mainly in the absence of an eye node in T. bathonica. A phylogenetic relationship is here implied with R. transversiplicata representing ancestral stock in the older Lias sediments.

Tethysia irregularis sp. nov.

(Pl. 30, figs. 3 - 8)

DERIVATION OF NAME. Latin, referring to the irregular nature of the surface ribs.

DIAGNOSIS. Tethysia with median rib discontinuous just in front of valve centre; posteriorly it divides into two short branches. Short oblique rib extends down from anterior cardinal angle to just above mid-point on anterior margin. Third rib extends down from gap in median rib to central part of ventral margin; fourth rib parallels ventral margin anteroventrally. Coarse reticulation covers shell surface.

MATERIAL. 35 valves and carapaces.

HOLOTYPE. Left valve, OS 11882, L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.

DESCRIPTION. Rectangular carapace with rounded anterior margin, straight dorsal and ventral margins and rather blunt, compressed posterior margin. Carapace longest medially, highest anteriorly and widest posteriorly. Cardinal angles distinct. Ribbing as diagnosed. Dorsal margin of both valves compressed into a distinct ridge forming a flattened dorsal surface expanded anteriorly and posteriorly. Eye nodes absent. Valves equal sized. Shell surface coarsely reticulate; few large normal pore canal openings with raised collars irregularly scattered. Carapace non-dimorphic.

Internally inner margin and line of concrescence do not completely coincide, producing a shallow vestibule anteriorly; duplicature moderately wide anteriorly and posteriorly. Hinge holoperatodont with, in RV, smooth terminal teeth separated by a straight, smooth median groove expanded slightly anteriorly and posteriorly. Muscle scars and marginal pore canals not visible.

DISTRIBUTION. This species has been recorded from the L. and M. Bathonian represented in the Port-en-Bessin section, Normandy Province and from the Dorset Province where it occurs in the basal L. Cornbrash only of the Seabarn Farm borehole (falcata Zone).

DIMENSIONS

			L	H	W	Locality
holotype,	LV,	OS 11882	.34	.19		F-PB.5.78
paratypes:	RV,	OS 11883	.32	.17		"
	car.,	OS 11884	.34	.18	.17	F-PB.7.78
	LV,	OS 11885	.34	.17		F-PB.5.78
	car.,	OS 11886	.34	.17	.17	F-PB.6.78
	car.,	OS 11887	.34	.18	.16	F-PB.21.78

ECOLOGY. Marine, shallow water; sublittoral to littoral environments.

REMARKS. T. irregularis is, at present, the largest species of the genus. The ornamentation differs from that of T. bathonica in the following respects: the median rib is discontinuous, the ventrolateral rib is more strongly developed and curves upwards more positively at its anterior end (in T. bathonica this sometimes bends down towards the anteroventral region), and the dorsal edge is more prominently developed into a flat ridge. The 2 are, nevertheless, very close and a relationship between them would seem probable. T. irregularis is geographically more restricted than T. bathonica and does not occur in large numbers. Whenever the 2 appear within the same sample it is T. bathonica which far outnumbers T. irregularis in terms of individuals present, suggesting that interspecific competition was detrimental to the latter. Dispersal of this species northwards from Normandy appears to have taken place only towards the close of the Bathonian, when T. bathonica had apparently died out.

Genus Rutlandella Bate & Coleman, 1975

DIAGNOSIS (emended). Carapace small (<.4 mm long), subquadrate in lateral outline, tapering posteriorly. Short alae posteroventrally. Eye node prominent. Shell surface reticulate or nearly smooth.

Hinge holoperatodont. Muscle scars an oblique row of 4 adductors with a rounded anterodorsal frontal scar and a small, rounded anteroventral mandibular scar. Duplicature broad; marginal pore canals straight, few in number.

TYPE SPECIES. Rutlandella transversiplicata Bate & Coleman, 1975.
REMARKS. The diagnosis is here emended to accommodate R. enigmatica sp. nov. which does not possess the coarse reticulate ornamentation of the original diagnosis.

Rutlandella enigmatica sp. nov.

(Pl. 30, figs. 9 - 15; pl. 31, figs. 1 - 3)

1976 Rutlandella sp. 1 Dépêche, pl. 2, fig. 1.
1979 Rutlandella sp. 1 Dépêche, figs. 1, 4 (1-5).
1979 Rutlandella (?) sp. Dépêche, figs. 5 (3-6), 6 (1-5)
1979 Orthonotacythere ? sp. Bate, fig. 5.

DERIVATION OF NAME. After the term used by Dépêche (1979), 'empreinte enigmatique', describing the rather unusual ornamentation features in this species.
DIAGNOSIS. Rutlandella with 4 lateral ridges; an oblique poorly developed median ridge, a ventrolateral ridge with alate extension, short anterodorsal ridge extending obliquely forwards from eye node, and short posterodorsal ridge. Faint surface reticulation sometimes present.
MATERIAL. Over 100 valves and carapaces.
HOLOTYPE. Right valve, OS 11888, L. Bathonian, Marnes de Port-en-Bessin, Normandy.
DESCRIPTION. Subquadrate carapace, tapering slightly to posterior. Greatest length occurs medially, greatest height anteriorly and greatest width posteriorly. Cardinal angles pronounced. Posterior termination compressed, forming a small caudal process. Alate extensions of valves developed posteroventrally, forming triangular ventral surface. Lateral ridges as for diagnosis. Triangular dorsal surface produced by posterodorsal ridges. Eye node smooth, prominent. RV larger than LV which it overreaches along dorsal margin and posterodorsal slope. Normal pore canals simple, numerous, irregularly scattered over shell surface. Surface reticulation very faint, absent in some specimens, with several distinct circular or subcircular, slightly raised, plate-like structures, comprising numerous

(approximately 18 - 35) rounded pits.

Inner margin and line of concrescence coincident- duplicature wide; marginal pore canals not observed. Hinge holoperatodont; in LV terminal smooth sockets separated by a smooth straight median ridge expanded slightly at either end; above ridge is a narrow accommodation groove. LV with corresponding opposing hinge elements. Muscle scars, slightly raised on external surface, a subvertical row of 4 oval adductors, rounded antero-dorsal frontal scar and small round anteroventral mandibular scar. Carapace non dimorphic.

DISTRIBUTION. This species has previously been recorded from the M. Bathonian, upper Marnes de Port-en-Bessin of Normandy (Dépêche) and as Orthonotacythere? sp. from the U. Bathonian U. Fuller's Earth of the Horsecombe Vale borehole, Bath. Herein, it is known from the L. and M. Bathonian at Port-en-Bessin and the U. Bathonian Forest Marble (blakeana Zone) of the Seabarn Farm borehole, Dorset.

DIMENSIONS.

			L	H	W	Locality
holotype,	RV,	OS 11888	.34	.19		F-PB.40.78
paratypes:	car.,	OS 11889	.34	.19	.14	F-A.3.78
	car.,	OS 11890	.34	.19	.14	"
	car.,	OS 11891	.32	.17	.14	F-PB.39.78
	RV,	OS 11892	.32	.18		F-PB.48.78
	LV,	OS 11893	.32	.17		"
	juv.car.,	OS 11894	.25	.14	.11	F-PB.52.78
	juv.car.,	OS 11895	.21	.11	.10	"

ECOLOGY. Marine, shallow water shelf, occurring within typically fine-grained offshore clay-type sediments.

REMARKS. R. enigmatica is quite distinct from the two English Lias species, R. transversiplicata and R. mimica in lacking the coarse reticulation present in both these. In her 1979 paper, Dépêche illustrated several species of Rutlandella which demonstrated various different types of surface ornamentation. The two species listed in the synonymy were photographically illustrated but her R. sp. 2, and R. sp. 3 were illustrated only by simple line drawings, thus making comparisons difficult. It would appear that all these are in fact

Explanation of Plate 31

Figs. 1 - 3. Rutlandella enigmatica sp. nov.: figs. 1, 3, LV, OS 11893 (.32 mm long): figs. 1, int. lat (x 156); fig. 3, hinge (x 450), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.48.78); fig. 2, juv. car., R side, OS 11894 (.25 mm long, x 200), L. Bathonian, as above (F-PB.52.78).

Figs. 5, 6. Rutlandella sp. 1, RV, OS 11896 (.33 mm long): fig. 5, ext. lat (x 121); fig. 6, detail of ornament (x 1K), L. Bathonian, as above (F-PB.40.78).

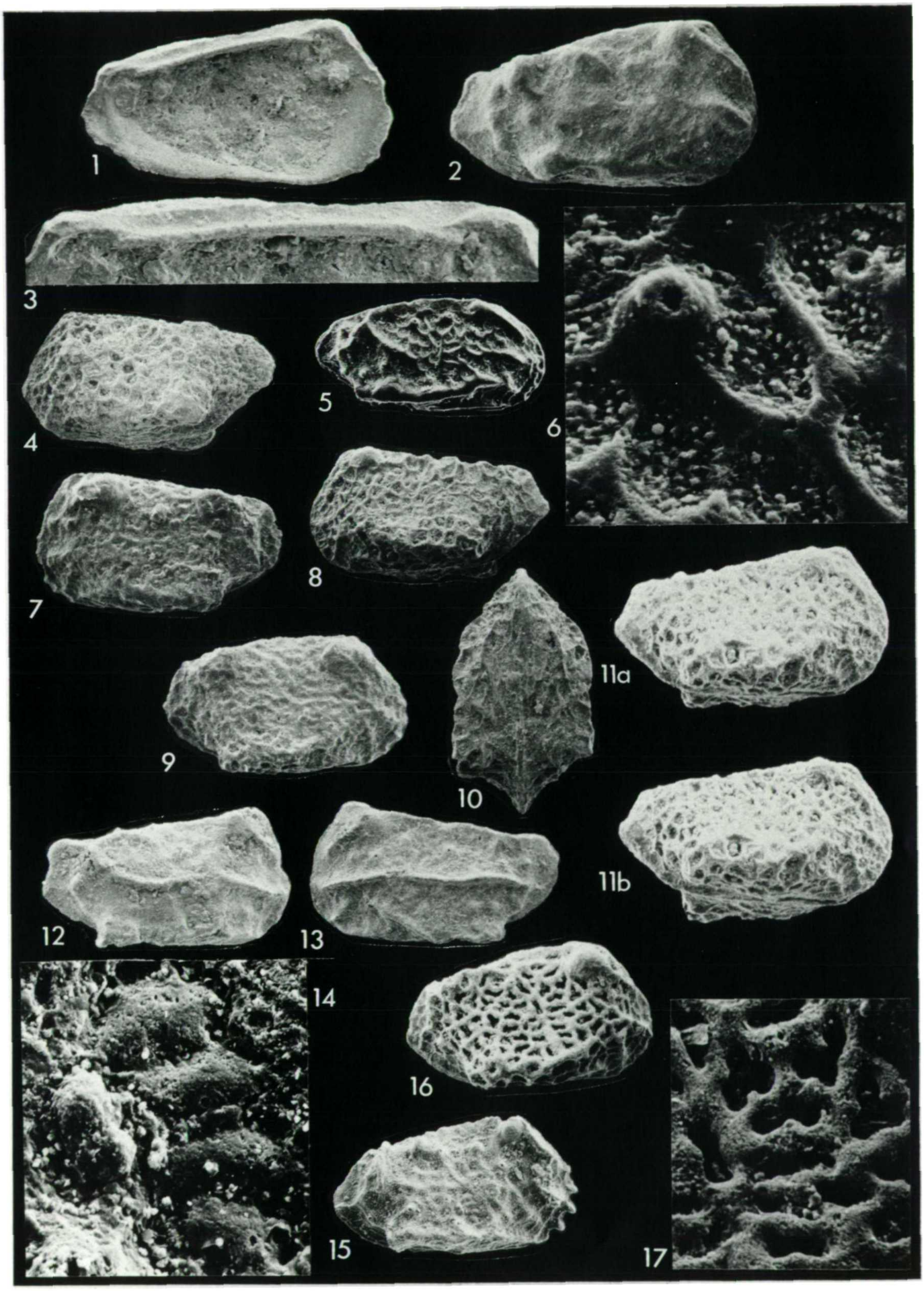
Figs. 4, 7 - 11. Eucytherura ursula sp. nov.: fig. 4, car., L side, OS 11899 (.33 mm long, x 121), M. Bathonian, Marnes de Port-en-Bessin (F-PB.18.78); fig. 7, LV, OS 11901 (.29 mm long, x 137), M. Bathonian, as above (F-PB.20.78); figs. 8, 11, holotype, car., OS 11897 (.29 mm long, x 137); fig. 8, L side; fig. 11, stereo-pair of R side, M. Bathonian, as above; fig. 9, RV, OS 11898 (.31 mm long, x 129), M. Bathonian, as above; fig. 10, car., vent., OS 11900 (.29 mm long, x 137), L. Bathonian, as above (F-PB.38.78).

Figs. 12, 13. Eucytherura sp. 1: fig. 12, RV, OS 11903 (.29 mm long, x 137), M. Bathonian, as above (F-PB.28.78); fig. 13, LV, OS 11902 (.27 mm long, x 148), M. Bathonian, as above (F-PB.27.78).

Figs. 14, 15. Eucytherura sp. 2, RV, OS 11904 (.31 mm long): fig. 14, muscle scars (x 1K); fig.15, ext. lat. (x 129), L. Bathonian, as above, Arromanches (F-A.4.78).

Figs. 16, 17. Eucytherura sp. 3, RV, OS 11905 (.30 mm long): fig. 16, ext. lat. (x 133); fig. 17, detail of ornament (x 560), U. Bathonian, St. Aubin Member, Reviers (F-Re.7.78).

PLATE 31



variations of the one species, R. enigmatica although without personal examination of each type this remains unproven. The interesting ornamentation features of this species are the rounded plate-like structures termed the 'empreintes engimatiques' which, according to Dépêches' theory, the outer layer of shell being weak and suffering decomposition in hexagonal areas forming a reticulation of raised and recessed plates, would be remnants of the outer layer of shell, resistant to decomposition. The precise function of these plates is unknown; they may be localised groups of normal pore canal openings in addition to single ones scattered over the shell surface. No internal evidence has yet been found, however, to demonstrate that these structures actually penetrate the total thickness of the shell. The position of the plates is more or less constant over the shell surface and, depending on the state of preservation, there are usually 7 per valve.

Within the study material are found specimens exhibiting varying degrees of decomposition of their outer shell layer and some smooth forms show no decomposition which forms supportive evidence of Dépêche's theory.

This species is not considered to belong to Orthonotacythere because the smooth hinge elements differ from the coarsely dentate/loculate elements of that genus.

Rutlandella sp. 1.

(Pl. 31, figs. 5, 6)

REMARKS. A single specimen of a new species of Rutlandella was found in the L. Bathonian Marnes de Port-en-Bessin, Normandy. This ostracod is characterised by having a strong ventrolateral rib extending up onto the lateral valve surface anteriorly, a short horizontal median rib in the anterior half of the shell, an oblique anterodorsal rib from the eye node and an oblique posterodorsal rib with a branch from this to the valve centre. A strongly developed coarse reticulation exists over the valve surface, with raised pore canal openings as in R. enigmatica. This species does not, however, possess the surface plate-like structures of R. enigmatica.

R. sp. 1 is not greatly dissimilar to R. transversiplicata Bate &

Coleman, 1975 which possesses the same basic arrangement of ribs and coarse reticulation but in that species the rib extending into the valve centre from the posterodorsal branch is longer and almost joins the short median anterior rib.

Genus Eucytherura Müller, 1894

Eucytherura ursula sp. nov.

(Pl. 31, figs. 4, 7 - 11)

DERIVATION OF NAME. Latin, meaning female bear cub, referring to its resemblance in lateral outline.

DIAGNOSIS. Eucytherura with coarse reticulation over shell surface. Ventrolateral margin extended, alate. Short posterodorsal projection; prominent rounded eye node.

MATERIAL. 4 valves, 6 carapaces.

HOLOTYPE. Carapace, OS 11897, M. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.

DESCRIPTION. Squat, subquadrate carapace with straight dorsal and ventral margins, broadly rounded anterior margin and posterior margin with caudal process in dorsal half; steep posteroventral slope. Ventrolateral margin alate with maximum extension in posterior half. Greatest length of carapace in dorsal half of shell, greatest width posteriorly and greatest height anteriorly. Cardinal angles pronounced. Large prominent smooth eye node. Anterior margin smooth or dentate. Posterior margin slightly compressed when viewed dorsally. Slight posterodorsal projection of valve giving some angularity to dorsal margin.

Hinge holoperatodont with, in LV, smooth median bar expanded terminally with narrow accommodation groove above; smooth terminal sockets. Inner margin and line of concrescence coincident producing a wide duplicature; marginal pore canals and muscle scars not visible.

DISTRIBUTION. Known from the L. and M. Bathonian Marnes de Port-en-Bessin of Normandy and, rarely, from the U. Bathonian U. Fuller's Earth (polonica Zone) of the Seabarn Farm borehole, Dorset.

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11897	.29	.17	.17	F-PB.20.78
paratypes:	RV,	OS 11898	.31	.17		"
	car.,	OS 11899	.33	.18	.17	F-PB.18.78
	car.,	OS 11900	.29	.17	.16	F-PB.38.78
	LV,	OS 11901	.29	.17		F-PB.20.78

ECOLOGY. Marine, shallow water offshore shelf.

REMARKS. The shape and coarse reticulation of this species are similar to that of *E. liassica* Bate & Coleman, 1975 from the Lias of central England but it lacks the short anterodorsal and anteroventral ribs characteristic of *E. liassica*.

Encytherura sp. 1

(Pl. 31, figs. 12, 13)

REMARKS. Several specimens of an, as yet, undescribed species of *Eucytherura* occurred within the lowermost M. Bathonian Marnes de Port-en-Bessin, Normandy. The species is characterised by an oblique lateral median rib, an anterodorsal rib and a posteroventral alate extension of the valve. This pattern of ribbing is similar to that found in *E. (V.) costae-irregularis* Whatley, 1970 from the U. Jurassic of Scotland and England but lacks the coarse reticulation of that species.

Eucytherura sp. 2

(Pl. 31, figs. 14, 15)

REMARKS. A single specimen of a new species of *Eucytherura* occurred within the L. Bathonian, Marnes de Port-en-Bessin at Arromanches, Normandy. It is characterised by having a finely pitted shell surface with anterodorsal and posterodorsal ribs, a posteroventral alate extension of the valve and a coarsely dentate anterior margin. Large, simple normal pore canal openings are scattered over the shell surface and the muscle scars, visible on the external surface, comprise 5 elongate-oval adductors and a rounded anterodorsal frontal scar.

This species differs from E. sp. 1 in lacking the prominent oblique median rib. It is distinguished from E. (Vesticytherura) scottia Whatley, 1970 from the U. Jurassic of Scotland, in lacking the second tubercle in the ocular region of the valve.

Eucytherura sp. 3.

(Pl. 31, figs. 16, 17)

REMARKS. A single specimen of this striking species of Eucytherura occurred within the U. Bathonian St. Aubin Member (falcata Zone) at Reviers, Normandy. In size and shape this is close to E. ursula but is distinguished by its pattern of ornamentation which consists of large, deep trefoil pits and elongate slit-like pits. This type of ornamentation is particularly rare in ostracods of Jurassic age, being more usually found in Cretaceous and younger genera.

Genus Paracytheridea Müller, 1894

Paracytheridea ? elegans sp. nov.

(Pl. 32, figs. 1 - 7; text-fig. 5 - 11)

DERIVATION OF NAME. Latin, after the elegant lines of the carapace.

DIAGNOSIS. Elongate rectangular carapace with dorsally situated acuminate posterior margin, rounded anterior margin. Three major longitudinal ribs on lateral surface, ventral one forming posteroventral alate extension. Intercostate areas reticulate. Flattened ventral surface.

MATERIAL. 24 valves and carapaces.

HOLOTYPE. Carapace, OS 11907, L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, Normandy.

Explanation of Plate 32

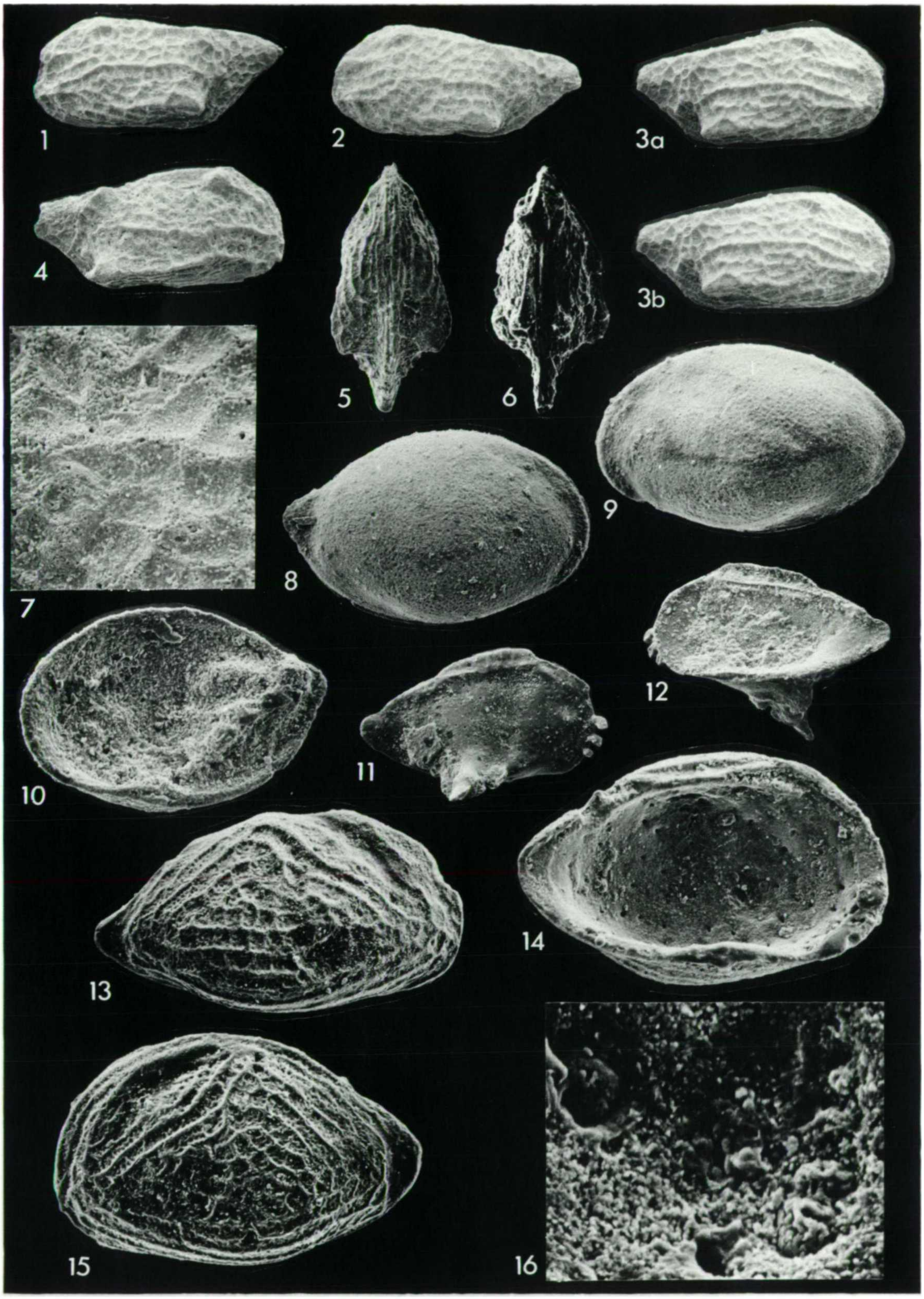
Figs. 1 - 7. Paracytheridea ? elegans sp. nov.: fig. 1, car., L side, OS 11494 (.33 mm long, x 121), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin (F-PB.36.78); figs. 2, 7, car., L side, OS 11908 (.33 mm long): fig. 2, ext. lat. (x 121); fig. 7, detail of ornament (x 1K), M. Bathonian, as above (F-PB.18.78); figs. 3, 5, holotype, car., OS 11907 (.34 mm long, x 117): fig. 3, stereo-pair of R side; fig. 5, vent., L. Bathonian, as above (F-PB.36.78); fig. 4, RV, OS 11909 (.33 mm long, x 121), M. Bathonian, as above (F-PB.26.78); fig. 6, car., dors., OS 11910 (.32 mm long, x 125), L. Bathonian, as above (F-PB.52.78).

Figs. 8 - 10. Citrella nitida Oertli: figs. 8, 10, RV, OS 11858 (.34 mm long, x 147): fig. 8, ext. lat.; fig. 10, int. lat.; fig. 9, LV, OS 11859 (.35 mm long, x 142). Both U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-Bo.3.79).

Figs. 11, 12. Pedicythere sp., RV, OS 11906 (.41 mm long, x 97), L. Bathonian, Marnes de Port-en-Bessin, Port-en-Bessin, (F-PB.9.78).

Figs. 13 - 16. Metacytheropteron drupaceum (Jones): figs. 13, 16, ♀ RV, OS 11912 (.42 mm long): fig. 13, ext. lat. (x 142); fig. 16, int., muscle scars (x 780), U. Bathonian, Forest Marble equivalent, Les Pichottes Quarry, Boulogne (F-BO. 2.79); figs. 14, 15, LV, OS 11495 (.48 mm long, x 208); fig. 14, int. lat.; fig. 15, ext. lat., U. Bathonian, as above.

PLATE 32



DESCRIPTION. Elongate rectangular carapace with straight dorsal and ventral margins, rounded anterior margin and dorsally situated acuminate posterior margin. Greatest length therefore in dorsal half, greatest height through anterior cardinal angle, greatest width in posterior third. Carapace posteriorly compressed when viewed dorsally. Three major longitudinal ribs on lateral surface; dorsal one forms flattened dorsal surface, median one extends from anteroventral position on anterior margin to just in front of steep posteroventral slope, ventral one forms postero-ventral alate extension which produces triangular flattened ventral surface. Eye node present. Coarse reticulation over valve surfaces. Small, simple normal pore canal openings scattered over shell surface. LV slightly larger than RV with overreach visible only along ventral margin. Carapace non-dimorphic.

Inner margin and line of concrescence coincide to form duplicature of moderate width. Marginal pore canals and muscle scars not observed. Hinge in RV a long, anteriorly convex, smooth groove with a single anterior terminal tooth (fig. 5 - 11).

DISTRIBUTION. Found only within the Bathonian sediments of the Normandy Province; the L. and M. Bathonian Marnes de Port-en-Bessin and the U. Bathonian Ranville Member (blakeana Zone) at Reviers.

DIMENSIONS.

			L	H	W	Locality
holotype,	car.,	OS 11907	.34	.16	.17	F-PB.36.78
paratypes:	car.,	OS 11908	.33	.14	.15	F-PB.18.78
	RV,	OS 11909	.33	.15		F-PB.26.78
	car.,	OS 11910	.32	.13	.16	F-PB.52.78
	car.,	OS 11494	.33	.15	.17	F-PB.36.78
juv.	car.,	OS 11911	.27	.12	.13	F-PB.26.78

ECOLOGY. Shallow water marine, inhabiting sublittoral offshore to littoral shore-line environments.

REMARKS. Paracytheridea is a Cenomanian to Recent genus which is typically heavily ornamented with ridges and/or tubercles and which has the alate extension of P. ? elegans greatly exaggerated into a wing-like process, often with a second marginal spine-like process between this and the posterior margin. For this reason and for lack of good internal features the generic assignment is queried. Two other questionably Paracytheridea species are known from the M. Jurassic; these are P. ? caytonensis Bate, 1965 from the U. Bajocian of N. England and P. ? blakei Bate, 1969 from the U. Bathonian U. Fuller's Earth of Bath. P. ? caytonensis has a nodose ornamentation and P. ? blakei has a similar reticulation to P. ? elegans but lacks the distinct lateral ridges.

It may be preferable to erect a new genus for these 3 species but for the present it is sufficient to retain them, on the basis of external shape, in Paracytheridea.

Subfamily CYTHEROPTERINAE Hanai, 1957

Genus Citrella Oertli, 1959

Citrella nitida Oertli, 1959

(Pl. 32, figs. 8 - 10)

1959 Citrella nitida Oertli, 118, pl. 2, figs. 16 - 19.

DIAGNOSIS. Oval carapace with small caudal process. Left valve larger than right; simple adont hinge. Shell surface smooth. About eight straight anterior marginal pore canals.

MATERIAL. 14 valves.

DESCRIPTION. See Oertli, 1959.

DISTRIBUTION. Previously known only from the U. Bathonian (falcata Zone) sediments of "Les Pichottes" Quarry, Boulogne and herein recorded from the same locality. The species is unknown from southern England and Normandy.

ECOLOGY. Very shallow water, marginal marine species, tolerant of brackish water conditions.

REMARKS. The very simple hinge structure, with the dorsal edge of the RV fitting into a groove in the LV, identifies C. nitida as a primitive member of the subfamily. In external morphology C. nitida is very close to the aptly named Micropneumatocythere quasicitrella Bate & Sheppard, 1979 from the L. Fuller'sEarth of the Horsecombe Vale borehole, Bath. The latter is distinguished by its antimerodont hinge and simple frontal scar that contrasts with the divided frontal scar of C. nitida.

Citrella is, at present, a monospecific genus.

Genus Pedicythere Eagar, 1965

Pedicythere sp.

(Pl. 32, figs. 11, 12)

REMARKS. A single specimen of a species of Pedicythere occurred within the L. Bathonian Marnes de Port-en-Bessin at Port-en-Bessin, Normandy. This species has a highly arched dorsal outline, long ventrolateral alate extension, smooth shell surface and 3 prominent short, stout spines on the anterior margin. The hinge is simply a straight, smooth furrow with a narrow smooth bar immediately above it. The dorsal convexity is caused by a prominent upstanding flange. The absence of terminal hinge elements distinguishes this species from all others of the genus. It is further distinguished from the type species, P. tessae Eagar, 1965, from the L. Eocene of Berkshire, in lacking a second posteroventral alate process and in having a more arched dorsal outline. The U. Jurassic species, P. anterodentina Whatley, 1970, from England and Scotland, is smaller than P. sp. (holotype length .35 mm compared with .40 mm for the latter) and has a straighter dorsal margin.

Despite the more simple hingement, this species is assigned to Pedicythere on size, alate extensions and lateral compression of the carapace. The lack of material at this stage has necessitated its open nomenclature. It is, at present the oldest record of the genus.

Genus Metacytheropteron Oertli, 1957

Metacytheropteron drupaceum (Jones, 1888)

(Pl. 32, figs. 13 - 16)

1884 Cythere drupacea Jones, 772, pl. 34, fig. 30.

1967 Metacytheropteron drupacea (Jones); Bate, 44, pl. 10, figs. 1 - 9.

1969 Metacytheropteron drupaceum (Jones); Bate, 393, pl. 5, figs. 4 - 6.

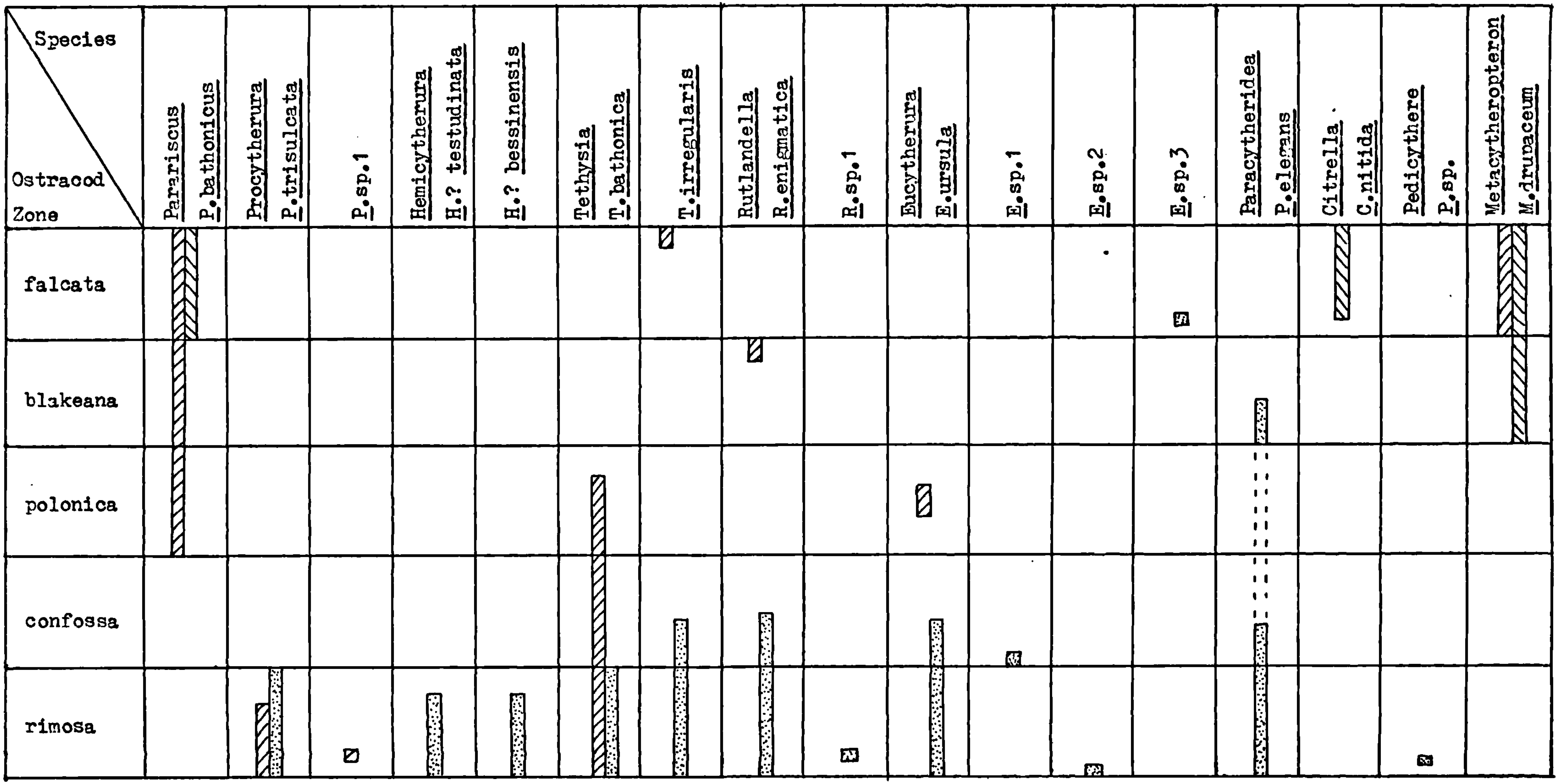


Table 5-16 Range table for members of the Cytheruridae.

DIAGNOSIS. Elongate/subovate carapace, highest anteriorly. Dorsal margin broadly convex especially in left valve, posterior margin acuminate. Shell surface strongly ornamented with triangular arrangement of longitudinal and obliquely transverse ridges.

MATERIAL. 33 valves and carapaces.

DESCRIPTION. See Bate, 1967.

DISTRIBUTION. M. drupaceum has previously been recorded from the U. Bathonian U. Estuarine Series of northern England (Bate, 1967), the Great Oolite of the Richmond boring, Surrey (type-locality) and the U. Bathonian Forest Marble equivalent of the Forest Marble in Boulogne (Oertli, 1957, Sheppard, 1981). It is also recorded from the L. to U. Bathonian sediments of the Bath area (Bate, 1979), ranging from topmost L. Fuller's Earth to the U. Fuller's Earth (rimosa to blakeana Zones). Within the study area the species occurs within the U. Bathonian (blakeana to falcata Zones) of the Kent-Boulonnais Province and the U. Bathonian Forest Marble and L. Cornbrash of the Dorset Province.

REMARKS. This species is dimensionally similar to the type-species M. elegans Oertli, 1957, from the U. Jurassic of the Paris Basin but the latter species lacks the prominent anterodorsal ribs that give the characteristic triangular pattern of ornamentation in M. drupaceum and also lacks the smooth caudal process of this species. The Callovian species M. sutherlandensis Whatley, 1970, from Scotland differs further by having a surface ornamentation of parallel longitudinal ridges; the anterodorsal and posterodorsal elements of M. drupaceum are absent.

CHAPTER 6

Aspects of Ecology.

The depositional environments of the sediments under discussion have already been mentioned in Chapter 2 and the broad palaeogeographic scene set. The study of the ostracod faunas suggests, however, that this picture is somewhat oversimplified. The stratigraphic value of ostracods has long been recognised and their importance as aids in palaeoecology has now, too, been widely accepted. Ostracods occur within a very wide range of environmental conditions; they include aquatic, terrestrial and interstitial forms. It is this aspect of their ubiquity i.e. their ability to live in a wide range of habitats which makes them such good ecological indicators and which Szczechura (1980) also believes is the cause of their speciation, with genetic isolation of local populations resulting from environmental changes. This study deals, in the main, with shallow water marine species of ostracods. In the Bathonian of Britain salinity is perhaps the most important parameter controlling the fauna, particularly well demonstrated to the north of the study area where fresh water assemblages have been recognised within marine sediments (indicating closeness to land) in the outcrop of Oxfordshire and to the north east. Ostracod distribution is important in determining possible dispersal routes in the geological record. Within the study area it will be shown how the distribution of certain key species affects the palaeogeographic interpretations. In the Dorset and Normandy Provinces, for example, lithologically similar beds which were apparently deposited under identical conditions do not contain identical ostracod faunas. Other faunal differences occur between the sampling provinces which throw a certain amount of light, not only on the ecological requirements of individual species but on the palaeogeographic significance of the fauna as a whole. The following pages outline these faunal discrepancies and the conclusions which may be drawn from them.

6-1 Distributional patterns.

The major parameters controlling the distribution of ostracods are substrate, temperature, salinity, food supply and hydrodynamics, in particular water depth (Szczechura, 1980). Many Bathonian ostracods are found in every ecological niche of this study; from relatively low-energy offshore regimes with fine grained clay/marl deposition, through every part of the continental shelf profile, to the high-energy beach environments and oolite shoals, often with interfingering brackish influences from nearby land. Such ubiquitous forms include Bairdia hilda, Cytherella fullonica, Palaeocytheridea carinilia, Nophrecythere rimosa, Fossaterquemula blakeana, Morkhovenicythereis bouvadensis and Praeschuleridea subtrigona subtrigona.

6-1-1 Temperature

It is not envisaged that temperature was a controlling factor within the limits of this study as the geographical extent of the study area is relatively small on a broad oceanographic scale.

6-1-2 Water depth

For many species the major controlling influence is water depth. The following represent those species which appear resticted to a shallow water marine environment, occupying the littoral to neritic regions where the sediments were deposited under relatively high-energy conditions: Acanthocythere (A.) spiniscutulata, Micropneumatocythere brendae, Glabellacythere dolabra and Oligocythereis fullonica.

Conversely, some species may be limited to that region of shoreline below the wave-base line where the deposits tend to be finer-grained and the conditions quieter, although current activity will still be important as a transporting mechanism. In some instances the species of a particular genus have similar ecological requirements, for example Monoceratina tends to be found within the deeper sub-littoral deposits. The genus is absent from the shallower deposits bordering the London-Brabant Massif in the Kent-Boulonnais Province (with, however, the notable exceptions of M. striata and M. ? sp., perhaps indicative that they really belong to a different genus). This is not a case of facies-control as Monoceratina occurs within the L. Bathonian clays of Normandy as well as the U. Bathonian calcareous marls and rubbly limestones of the Dorset Province.

Ostracods appearing to be restricted to a deeper marine shelf environment include Tethysia bathonica sp. nov., Paralophocythere chonvillensis, Kinkelinella malzi, Pseudoprotocythere bessinensis and Nophrecythere bessinensis.

6-1-3 Salinity

The ostracods so far mentioned have been purely marine in habit. A small number of the total fauna, however, comprise brackish, euryhaline and, to a lesser extent, freshwater species. Excellent examples of shallow water marine areas with lagoons of reduced salinity in which occur a mixed assemblage of marine, brackish and freshwater forms have been documented for the Bathonian outside the study area (e.g. Bate, 1965 and Ware and Whatley, 1980, both papers dealing with the mixed assemblages of the U. Bathonian in Oxfordshire). Within the study area the U. Bathonian sediments bordering the London-Brabant Landmass in the Kent-Boulonnais Province yield good evidence of a similar environment as in Oxfordshire. The Boulonnais sediments (Oertli, 1957) demonstrate marine bands with shallow water marine ostracods in association with foraminifera, alternating with brackish sediments in which euryhaline ostracod species, in association with land plant debris and charophyte gyrogonia, are abundant. In the Kent region the shallow water shore-line deposits of the Forest Marble and L. Cornbrash have frequent sandy horizons with breaks in sedimentation, sun-cracks and plant debris; the ostracod fauna is typically of shallow water marine species with some euryhaline forms, suggesting the environment to be one of a shallow shelving beach with occasional sand bars, some of which having land-locked bodies of water behind them of reduced salinity. The euryhaline species within the Kent-Boulonnais Province include Micropneumatocythere quadrata, Konarocythere alpha, Lesleya bathonica, Glyptocythere penni and G. guembeliana.

The Dorset and Normandy Provinces are almost entirely marine in their ostracod faunas, with some euryhaline forms appearing in the U. Bathonian when there was a gradual shallowing of the sea in these two regions. The only specimens of presumed freshwater species, however occur in both areas; in the Forest Marble of the Seabarn Farm borehole and in the equivalent St. Aubin Member of Reviers. In both cases single specimens of two species of Limnocythere occur within an otherwise marine assemblage. Although being allochthonous, the specimens are reasonably well preserved, suggesting a minimum of transport damage and therefore of the existence of land nearby.

6-1-4 Substrate

Ostracods have, by convention, always been thought of as being facies-controlled. While this is true for some it is by no means true for all and because of this it is the latter that are biostratigraphically important. Those species which are restricted to a particular sediment-type were most probably bottom dwellers or burrowers. Distribution of the non-restricted forms was probably affected more by the distribution of the plants on which they lived than on the sediment-type (Bate, 1978).

6-1-4-1 Species restricted to a carbonate facies.

These include Ptychobairdia limbata sp. nov., Anchistrocheles ? spinosa sp. nov., Dromacythere sagittata and Rectocythere sugillata. These species show a high degree of calcification of their shells with a stout surface ornamentation adapting them to a shallow high energy environment.

6-1-4-2 Species restricted to a clay facies

To be a useful comparison to the above a shallow water clay facies is used here. Marine clays are generally deposited in deeper water than are limestones but the rhythmic clay sequences which alternate with the cross-bedded limestones in the Normandy U. Bathonian and the interbedded clays of the Forest Marble in Dorset are considered shallow water in origin (see Penn & Wyatt, 1979 and Palmer, 1979). Species restricted to such a clay facies include Pleurocythere viriosa, Micropneumatocythere triangula and Glyptocythere minima.

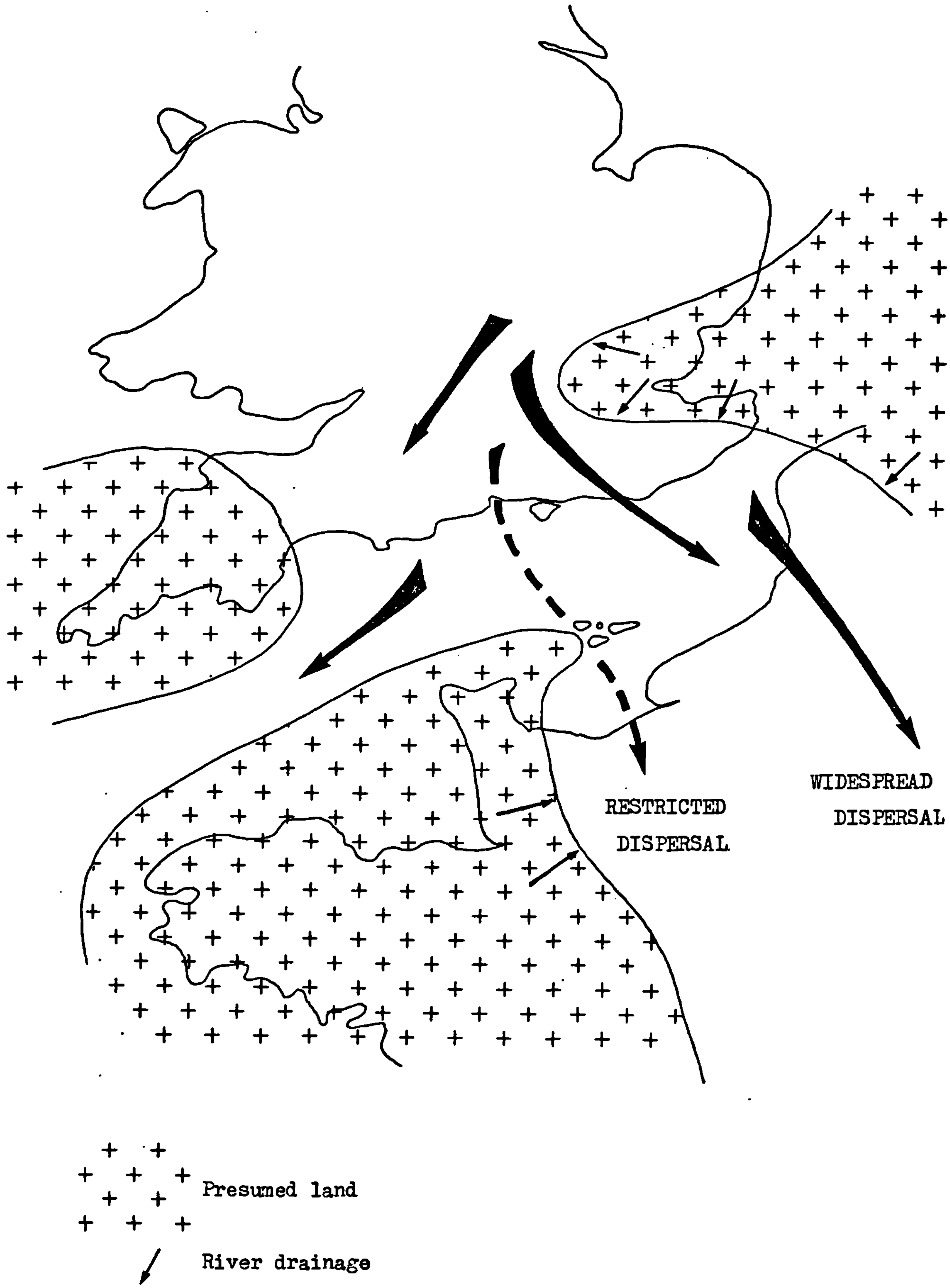
6-1-4-3 Species not facies-controlled.

Species which occur within clays, marls and limestones in equal abundance with apparently no preference for any sediment-type are not, therefore, facies-controlled and include all the biostratigraphically important ostracods. All the species listed in section 6-1 belong in this category together with such forms as Lophocythere ostreata, Acanthocythere (A.) sphaerulata, Micropneumatocythere brendae, Cytherelloidea catenulata and Oligocythereis ranvillensis sp. nov.

6-2 Palaeogeographic implications

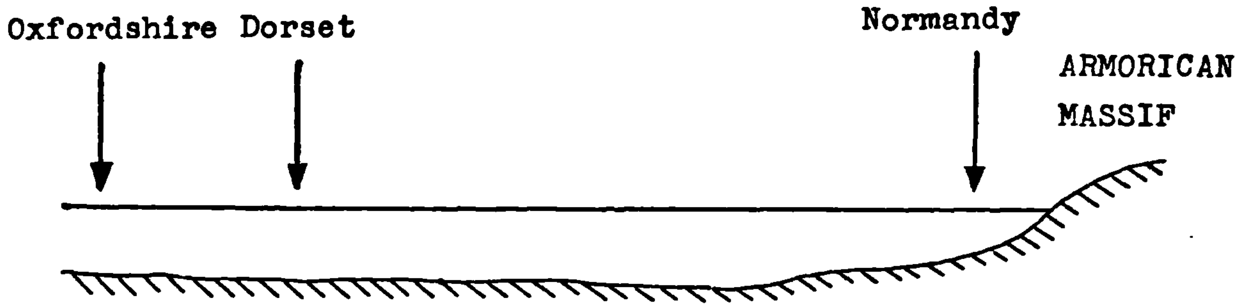
The basic Bathonian ostracod fauna remains constant throughout the three sampling provinces. Certain forms, however, are restricted to one or two provinces with access to the third inhibited. In some cases this is easily explained in terms of preference for a very limited type of habitat, being adapted to survive in that habitat and none other. These cases apart there exist many discrepancies between the faunas, both in the L. and U. Bathonian, between the Dorset and Normandy Provinces. Many species are missing from Normandy although they are common faunal elements in Dorset and Kent-Boulonnais. These include Parariscus bathonicus, species of Lophocythere, Terquemula, Glyptocythere, Fastigatocythere, Marslatourella and Progonocythere. Species of Micropneumatocythere, which are rare in Normandy, are abundant in the other two provinces. This suggests a very definite barrier to dispersal, either in terms of a land barrier, an abrupt change in water depth or a change in temperature, between Normandy and Dorset. A drastic temperature change seems unlikely as the distance between the two areas is relatively small. A land barrier, with an associated decrease in water depth, need not be very extensive. What is envisaged here is the presence, during the L. Bathonian, of a prominent headland in the N.E. corner of the Armorican Massif with associated small islands. It is unlikely that any landmass is as uniformly shaped as those depicted in fig. 2 - 3 in Chapter 2; headlands, bays, islands etc. must have been present so a minor adjustment to this part of the coastline does not contradict anyprevious palaeogeographic reconstructions. The islands would probably have been emergent only in M. and U. Bathonian times when there was a marked shallowing of the sea. In L. Bathonian times they would have been present as possibly submarine banks or dunes which inhibited southerly movement of sublittoral forms. Figure 6 - 1 shows

Figure 6-1 Palaeogeographic interpretation of the study area during the Bathonian, based on the ostracod distribution and dispersal patterns.

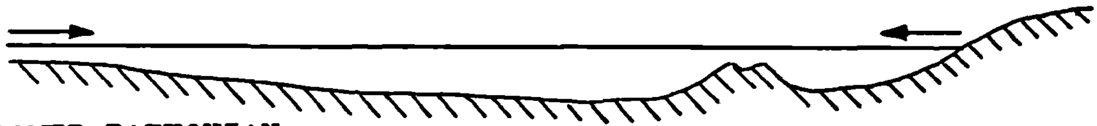


the slightly revised palaeogeographic map and the possible dispersal routes open to the ostracods. It is based on forms such as Lophocythere ostreata whose pattern of distribution implies a south-south easterly movement from central England into N.E. and E. France (where it occurs in younger sediments). Similar dispersal routes are also envisaged for species such as Fastigatocythere juglandica, Monoceratina vulsa, Praeschuleridea subtrigona subtrigona and Cytherella fullonica. Associated with the presence of islands as a barrier to dispersal may have been a deep submarine channel a short distance offshore the Armorican Landmass. The evidence for a gradual deepening of the sea in a south westerly direction from Oxfordshire, through Hampshire to Dorset and into the present Channel and Western Approaches area has already been presented in Chapter 2. The northern coastline of the Armorican Massif must have shelved considerably to account for the extensive thickness of sediment at its N.E. end (Normandy). A deep channel running along the central course of the English Channel would have provided an extra physical barrier to some species in addition to that formed by the islands. The fluctuations in water depth in the Normandy region during deposition of the rhythmic U. Bathonian sediments have, in Chapter 2, been accounted for by changes in configuration of the Armorican Massif coastline. Any small islands present would therefore have been transitory features; by Callovian times marine transgressions resulted in withdrawal of all the emergent areas in this northerly Paris Basin area with disappearance of all minor islands and subsequently through-routes to ostracod dispersal were opened. It would seem likely, too, that in Pre-Bathonian times the barrier was not in existence as the same indigenous populations on either side of the English Channel were well established by late Bajocian times. Fig. 6-2 shows suggested cross-sections from Oxfordshire to Dorset and across to Normandy, from U. Bajocian to Callovian times.

Not all species show south-south easterly dispersal routes. Some, e.g. Monoceratina scrobiculata, are widespread throughout N.W. Europe and move northwards into southern England and beyond during the Bathonian. This species is a common element of the L. Bathonian fauna of Normandy but is rare in the equivalent beds of Dorset. It is not until the Callovian and Oxfordian that it becomes widespread in England and Scotland (Whatley, 1970)

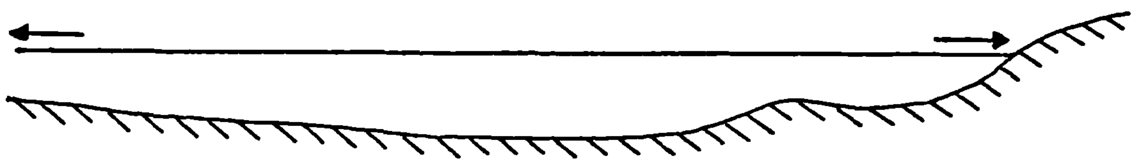


A UPPER BAJOCIAN



B LOWER BATHONIAN
Dispersal routes of ostracods become restricted.

C UPPER BATHONIAN
Shallowing of sea over whole area, followed by gradual deepening again in Normandy with fluctuations in Armorican coastline.



D CALLOVIAN
Marine transgressive phase.

Figure 6-2 Postulated fluctuations in vertical profile with time from southern England to Normandy.

and, being a sublittoral species, lends further support to the existence of a land barrier. It is not possible at this stage to theorise on possible E - W movements of species from Boulonnais to Normandy as no material of L. and M. Bathonian age has been examined from Boulonnais.

In the Normandy area the coastline remained constantly to the W., shifting slightly eastwards with deposition of the Calcaire de Caen, being a shoreline deposit (see p. 15), and then receeding again during U. Bathonian times. The Calcaire de Caen itself contains a very disappointing fauna. Nowhere in the Bathonian here are found estuarine or deltaic deposits to indicate the precise position of the coastline. The freshwater ostracod, Limnocythere sp. previously mentioned, could have been washed into the area either from a river flowing eastwards off the Armorican land or from the postulated islands a short distance to the north. In Dorset, however, the origin of the species of Limnocythere found there is rather more uncertain. The Cornwall Platform to the west is the closest emergent area although Ware (1980, British Micropalaeontological Society meeting address, as yet unpublished) has discovered evidence of close proximity to land within the Forest Marble of Tarlton, Gloucestershire, to the north. He has postulated the existence of small islands in this vicinity, due to the discovery of fresh water and brackish species of ostracods, and the present material may therefore be derived from this source.

The position of the London-Brabant Massif coastline remained fairly constant throughout the Bathonian and the sedimentological evidence for very shallow waters with breaks in sedimentation is well supported by shallow water ostracod species in association with euryhaline forms.

CHAPTER 7

Bathonian correlation.

The need for a correlation of Bathonian strata based on a fossil group other than ammonites has been briefly discussed in Chapter 1. The value of using ammonites in other parts of the geological column is not disputed where the same sequences of species are found over large areas, often even intercontinentally. It is the Bathonian ammonite zonation which cannot here be accepted, nor can Torrens' statement (1980, vol. 1, p. 5) that ..... 'Jurassic ammonites allow one to correlate different rocks to a finer biostratigraphic resolution than any other group of fossils'. With the increased subsurface exploration, both onshore and offshore, the advantage of using a microfossil group for correlation is obvious where macrofossils will be rare and/or broken and dating by means of lithologies alone highly dubious. The following pages present the case for using ostracods as this alternative means of correlation.

As Hedberg states in the International Stratigraphic Guide (1976, p. 63) biostratigraphical correlation is not necessarily the same as time correlation. The use of fossils in providing time correlation has been termed biochronology (Tozer, 1971, p. 990) and is the Standard Biostratigraphy of Callomon and Donovan (1974) and also arguably equivalent to Hedberg's chronostratigraphy. Many workers, however, believe that there is no practical difference between chronostratigraphy and carefully chosen biostratigraphy. It is the intention here to present an ostracod zonation which can be used as a standard with which to correlate the various lithologies represented in southern England and northern France, and which comes as close as possible to being a chronostratigraphic correlation. The existing ammonite zonation is referred to and the anomalies between the two demonstrated.

7-1 The suitability of ostracods as tools for correlation.

The types of environments inhabited by the ostracods under discussion have been dealt with in the preceding chapter. It is stressed that, contrary to the belief of some ostracod workers and stratigraphers alike, the evidence suggests that many species are facies-independant and that, if chosen carefully, may be reliably used for zonation and correlation. This is in direct disagreement with Torrens (1980, vol. 1, p. 8) who suggests that ostracods are far from ideal in effecting time correlations of rocks as the stratigraphic ranges of species may be ecologically-controlled rather than time-controlled. Certainly, it cannot be denied that some species prefer a particular type of substrate and are consequently extremely provincial in their distribution. These species are useful as indicators of ecology rather than of age, and examples of such ostracods are given in Chapter 6. It is essential, therefore, to recognise those forms that are biostratigraphically important as against those that are not.

The Bathonian sediments within the study area were deposited largely under shallow water marine conditions, some areas marginal to land masses. The advantage of using ostracods over ammonites is immediately obvious; ammonites are purely marine in habit and do not tolerate waters of reduced salinity, or even of shallow depth, as are commonly found near land. They consequently rarely occur under such conditions. Furthermore, in those sediments which do contain ammonites faunal restriction due to facies-control has been recognised, particularly, for example, within assemblages of the morrisi and subcontractus Zones. These ammonites occur in carbonate sediments and have not been found preserved in clays (Torrens, 1971, p. 590). Wyatt and Penn (personal communication) are convinced that the presence of these ammonites in both the Fuller's Earth Rock and the base of the younger White Limestone in the same order (i.e. subcontractus beneath morrisi) reflects this and the two units should not be correlated as time equivalent. Rather, the entire period of time between commencement of the Fuller's Earth Rock and the deposition of the White Limestone is represented by one ammonite zone only, morrisi and subcontractus being inseparable, and that the appearance of the subcontractus ammonites within the White Limestone is merely an example of a species ranging up beyond its own standard Zone. The reader is referred to Chapter 2 for a brief discussion of the ammonite Zones within the study area.

7-2 Ostracod Zonation

Today, several types of biozones are in common use but for the purposes of this study Standard Zones have been adopted. A Standard Zone is identified by the first appearance of its index fossil and terminated by the index fossil of the following Zone. The index fossil may range through the Zone or extend up into the Zone above; it is not essential that it is present throughout the entire Zone as the species may die out before the next zone fossil appears. By defining only the base of each Zone this obviates any possible problems of overlap or underlap which could arise by defining both the top and base of each unit. In addition, each Zone is further identified by a characteristic assemblage of species, some faunal elements of which may form part of the assemblage above or below. In the taxonomic treatment of the ostracods, Chapter 5, the biostratigraphically important species have been identified under their 'Remarks' section.

The Zones around which this biostratigraphic study is based have already been referred to by specific name in the preceding chapters; while it may seem out of place to define and describe these Zones after they have already been used it is at the same time crucial that the taxonomy be established first as a zonation scheme is, after all, dependant on using correctly identified species. First introduced as a series of eight numbered Zones by Bate (1978), reduced to five (Sheppard, 1978), they have since been replaced by named Zones by Sheppard (1981, in press). These Zones are here defined and their characteristic assemblages fully described. The lithostratigraphical units to which each Zone applies are listed for each and the whole summarised as a correlation Table, Table 7-1. The relationship of the ostracod zonation to the currently accepted ammonite zonation is presented and discussed. The ostracod Zones for the Bathonian are dealt with in ascending order.

7-2-1 Nophrecythere rimosa Zone

This Zone commences in the topmost Bajocian sediments with the first appearance of its zonal index, N. rimosa (Dépêche, 1973) which ranges throughout the entire Bathonian to die out at the base of the Cornbrash. The Zone, which is taken to represent the Lower Bathonian, is divided into three Subzones, each clearly identifiable in the Dorset and Normandy Provinces.

7-2-1-1 Nophrecythere rimosa Subzone

The lowermost Subzone, this commences with the first appearance

STAGE		OSTRACOD ZONE		DORSET PROVINCE	NORMANDY PROVINCE	KENT - BOULONNAIS PROVINCE	AMMONITE ZONE	
B A T H O N I A N	UPPER	falcata		L Cornbrash	L Cornbrash	L Cornbrash	discus	discus
				Forest Marble	Langrune Member	Forest Marble (+ equiv.)	hollandi	
					St Aubin Member			
		blakeana		boueti Bed	Ranville Member		aspidoides	
				Frome Clay		Great Oolite		
				wattonensis Beds	Campagnettes Member			
		polonica		Upper Fuller's Earth	Blainville Member	Upper Fuller's Earth	hodsoni	
							morrisi	
	MIDDLE	confossa		Fuller's Earth Rock		not studied	subcontractus	
					Calcaire de Caen			
	LOWER	rimosa	post-angusta	Lower Fuller's Earth	Marnes de Port-en-Bessin		progracilis	
			batei				tenuiplicatus	
			rimosa		Passage Beds		zigzag	
BAJOCIAN				Inferior Oolite	Inferior Oolite	Inferior Oolite		

Table 7-1 Correlation of Bathonian sediments using a standard Ostracod Zonation.

of N. rimosa in the topmost part of the Inferior Oolite in Dorset and the Oolithe Blanche in Normandy. It is a relatively narrow Subzone, including within it only a small part of the Bathonian; the lowermost few metres of L. Fuller's Earth in Dorset and the basal part of the Passage Beds in Normandy. The fauna typically includes Bairdia hilda Jones, B. pumicosa sp. nov., Pontocyprella subaureola sp. nov., Kinkelinella malzi (Dépêche), Tethysia bathonica sp. nov. and Palaeocytheridea carinilia (Sylvester-Bradley).

7-2-1-2 Eoschuleridea batei Subzone

This Subzone is marked by the first appearance of Eoschuleridea batei Dépêche in the lower few metres of L. Fuller's Earth in Dorset and within the Passage Beds in Normandy. The fauna differs little from that of the preceding Subzone, with Paracypris terraefullonicae (Jones & Sherborn), Monoceratina scrobiculata and M. striata Triebel & Bartenstein as common elements. The Subzone represents about 15 m of the lower part of the Marnes de Port-en-Bessin, including the upper part of the Passage Beds, in Normandy; in the Dorset Province it is more usually 20 - 30 m thick within the L. Fuller's Earth.

7-2-1-3 Merocythere postangusta Subzone

The thickest of the three rimosa Subzones, this includes the upper part of the L. Fuller's Earth in Dorset (approximately 20 - 60 m depending on the locality within the Province) and most of the upper part of the Marnes de Port-en-Bessin and lower part of the laterally equivalent Calcaire de Caen in Normandy. It is identified by the first appearance of Merocythere postangusta Sheppard; the fauna comprises Pseudoprotocythere ? bessinensis Dépêche & Oertli, Oligocythereis ranvillensis sp. nov., O. fullonica (Jones & Sherborn), Ljubimovella sp. and Metacytheropteron drupaceum (Jones), in addition to those species occurring within the rimosa and batei Subzones.

7-2-2 Praeschuleridea confossa Zone

This Zone represents the Middle Bathonian sediments and is recognised in the Dorset and Normandy Provinces. The Zone is identified by the first appearance of Praeschuleridea confossa Sheppard, 1981 in association with the following assemblage of species: Praeschuleridea subtrigona subtrigona (Jones & Sherborn), 'Cytheridea eminula' Jones &

Sherborn, in Bate, 1969 (a species needing revision which occurs frequently within sediments of M. and U. Bathonian age), Cytherelloidea catenulata (Jones & Sherborn) and Paracytheridea ? elegans sp. nov. Palaeocytheridea carinilia is a common species here, so too is Morkhovenicythereis bouvadensis (Dépêche). The Zone incorporates the topmost few metres of L. Fuller's Earth and the greater part of the Fuller's Earth Rock in Dorset. In Normandy the zonal index, P. confossa, is missing although the remainder of the assemblage is present. This is the only example of a zonal species being absent from one of the sampling provinces in the study area; the faunal assemblage is here regarded as characteristic of the Zone. P. confossa occurs within the Kent-Boulonnais Province where it ranges above the M. Bathonian Zone into the U. Bathonian polonica Zone of the Grove Hill borehole (the underlying L. and M. Bathonian sediments being poorly sampled and with few ostracods). Its' absence in Normandy was probably, therefore, related to the dispersal barrier postulated in Chapter 6 rather than to a facies restriction. The confossa Zone in Normandy is represented by the top few metres of Marnes de Port-en-Bessin (including, presumably, the overlying sandstone, the 'Grès du Planet' although this bed is completely devoid of ostracods) and the greater part of the Calcaire de Caen.

7-2-3 Strictocythere polonica Zone

Identified by the first appearance of Strictocythere polonica (Blaszyk), this Zone is recognisable in the Dorset and Normandy Provinces and, to a lesser extent, in the Kent-Boulonnais Province. The typical faunal assemblage includes Terquemula chonvillensis (Dépêche), Micropneumatocythere brendae Sheppard, Praeschuleridea subtrigona subtrigona (Jones & Sherborn), Lophocythere batei (Malz), Eudechacythere batei sp. nov., Morkhovenicythereis bouvadensis (Dépêche), Monoceratina vulsa (Jones & Sherborn), Ektyphocythere parva Oertli and Genus B of Bate, 1979. The Zone incorporates the topmost Fuller's Earth Rock, entire U. Fuller's Earth and lowermost Frome Clay in the Dorset Province, the U. Fuller's Earth at least within the Kent-Boulonnais Province (the Zone is recognised only within the Grove Hill borehole where there is a break both in sedimentation and in sampled horizons between the U. Fuller's Earth and the Forest Marble), and in Normandy the Blainville Member and the lowermost Campagnettes Member.

7-2-4 Fossaterquemula blakeana Zone

This Zone is easily identifiable in all three provinces by the first appearance of F. blakeana (Jones) in association with the following characteristic fauna: Terquemula bradiana (Jones & Sherborn), T. acutiplicata (Jones & Sherborn), Glabellacythere dolabra (Jones & Sherborn), Glyptocythere oscillum, G. guembeliana (Jones), Micropneumatocythere brendae Sheppard, M. subconcentrica (Jones), Schuleridea (Eoschuleridea) trigonalis (Jones), Acanthocythere (A.) sphaerulata Sylvester-Bradley and Genus B of Bate, 1979. Many of the species first appearing in the L. and M. Bathonian sediments flourish within this Zone. The boundary between this and the underlying polonica Zone is interesting as it represents the mid-point in an evolutionary sequence between Strictocythere polonica and F. blakeana. As the two Zones in all three provinces are represented by very different facies-types this evolutionary sequence can be regarded as a time-controlled, rather than an environmentally-controlled, phenomenon, and in terms of correlating the different beds involved,is very reliable. G. oscillum, which was originally used as zone fossil for Zone 5 of Bate, is an important member of the fauna for the correlation of beds in southern and central England although absent from Normandy. The blakeana Zone spans the Frome Clay (apart from the lower part of the wattonensis Beds at its base) and the boueti Bed at the base of the Forest Marble in the Dorset Province. In the Kent-Boulonnais Province the upper part of the Great Oolite and basal Forest Marble belong in this Zone. It is here felt that the boundaries drawn between the Great Oolite and Forest Marble within the older Kent Coalfield boreholes are highly inaccurate and in many cases there is no lithological or macrofossil faunal change on which the boundary is based; the ostracod data presented here represents the first real evidence on which to correlate between the borehole sections and the lithostratigraphic boundaries are adjusted accordingly.

Within the Normandy Province the major part of the Campagnettes Member and the entire Ranville Member limestones are included within this Zone.

7-2-5 Micropneumatocythere falcata Zone

This Zone incorporates all the Upper Bathonian sediments above the blakeana Zone and is equivalent to the discus ammonite Zone. The precise upper limit of the Zone is uncertain as the L. Cornbrash has yet to be extensively studied. For the purposes of this thesis, however, the boundary is drawn at the top of the L. Cornbrash i.e. at the top of the discus ammonite Subzone. The Zone is clearly identifiable in all three provinces and is recognised by the first appearance of its index fossil, M. falcata Sheppard in association with the following assemblage of species: M. subconcentrica (Jones), Fastigatocythere juglandica (Jones & Sherborn), Konarocythere alpha gen. et sp. nov., Lophocythere propinqua Malz, Parariscus bathonicus Oertli, Glabellacythere dolabra (Jones & Sherborn), Schuleridea (Eoschuleridea) trigonalis (Jones), Acanthocythere (A.) sphaerulata Sylvester-Bradley, Pichottia muris Oertli and Terquemula bradiana (Jones & Sherborn).

In the Dorset and Kent-Boulonnais Provinces, therefore, the majority of the Forest Marble (and equivalent beds) and the L. Cornbrash belong in this Zone; in Normandy the St. Aubin and Langrune Members are included within it (the L. Cornbrash has not, unfortunately, been sampled here).

7-3 Conclusions

The correlation of Bathonian sediments within the study area, based on the ostracod zonation, is presented in Table 7-1.

From the previous section, 7-2, it is evident that some Zones, in particular the L. Bathonian rimosa Zone, are represented by variable thicknesses of sediment or they may even be absent altogether, as is the case in the Kent-Boulonnais Province. The differences in thickness are considered to be reflections of the slightly different environmental conditions and/or of the post-depositional history of the sediments concerned. For example, the Subzones of the rimosa Zone are thicker in Dorset than they are in Normandy; this could be due either to slightly deeper waters in Normandy during the L. Bathonian resulting in slower sedimentation rates, or to a greater degree of post-depositional compaction of the sediments in this region.

The sediments within the Kent-Boulonnais Province are much condensed owing to the nearness of land during the entire Bathonian. The major problem in identifying the Zones here, however, lies in the nature of the sediments and the paucity of material available for sampling, particularly within the lower part of the sequence. Many of the older subsurface sections have been catalogued in such a way that it is virtually impossible to carry out a detailed biostratigraphic study, depths of rock samples being given very inaccurately. The L. and M. Bathonian sediments were not represented in the borehole material examined, either because of non-deposition or because the few samples retained have since been utilised by other workers. The lower part of the U. Bathonian is poorly represented but this is not the case for the Forest Marble (and equivalent beds in Boulonnais) which has yielded a very good ostracod fauna.

Lithologically the U. Bathonian sediments of Dorset and Normandy are vastly different but despite this the ostracod Zones have proved to be reliable. The broad-scale cyclic nature of the sediments in Normandy might suggest that the ostracods within the shallower water cross-bedded Members (i.e. the Ranville and Langrune Members) represent re-worked forms from the underlying sediment. While whole carapaces and good preservation would indicate that this is not so the possibility cannot be ruled out that some reworking may have occurred within the basal part of the higher energy sediment. No zonal boundaries occur either within the cross-bedded Members or at the junctions between these and the underlying Members, however, so that such slight reworking does not affect the Zones themselves. Normandy is the only region within the study area exhibiting such clear-cut cyclicity on a relatively broad scale.

The relationship between the ostracod and the ammonite Zones is given in Table 7-1. The boundaries between the ammonite Zones are only tentatively drawn as the current state of knowledge is so uncertain. Furthermore, the existence of the tenuiplicatus Zone seems doubtful as it is thought that this and the underlying zigzag Zone could be time-equivalents (Torrens, 1980, vol. 2, p.22) while some French workers (e.g. Mouterde et al., 1971) have advocated the abandonment of the progracilis Zone, thus extending the vertical range of the underlying Zone. The problems of the morrisi and subcontractus Zones have been mentioned earlier, in Normandy these ammonites occur in the 'Caillasse de Longues et de Marigny' which outcrop to the E. of the area studied - these beds are thought to be equivalent to the 'Calcaire de Blainville et de Colombelles'

(= Blainville Member) on field evidence along. Hodsoni ammonites have nowhere been found in Normandy, and the boundary between the discus and aspidoides Zones is difficult to place because the base of the discus Zone is poorly developed in both southern England and northern France; it is generally taken above the boueti Bed, at the base of the Digona Bed within the Forest Marble in Dorset and at the base of the St. Aubin Member in Normandy. Thus with this ammonite zonation, vague in the extreme, there is a real need for a more precise zonal scheme with easily recognised zonal boundaries; this has been achieved here through the study of the ostracod faunas, the Zones established permitting a precise correlation between beds of southern England and Normandy.

A significant alteration to the French succession of previous workers, observed as a result of this ostracod zonation, has been the omission of two lithostratigraphic units (see Table 2-3 in Chapter 2). These units, the 'Calcaire de Reviers' (Revier Member) and the 'Caillasse de Fontaine-Henry' (Fontaine-Henry Member), lying between the 'Calcaire de Caen' and the 'Calcaire de Blainville', have previously been recorded from Normandy by Guillaume (1927, 1929), Mercier (1932), Parent (1939), Rioult (1962), Palmer (1974) and Fily (1978) and are recognised on lithological evidence. The ostracod data presented here provides convincing evidence by which to date these sediments. The fauna obtained from the two units at Reviers, Fontaine-Henry and Pierrepont comprise typical U. Bathonian species and as such these units cannot be assigned to the M. Bathonian (recognised by a confossa Zone fauna) as was thought to be the case by the authors above. The Calcaire de Reviers is lithologically a coarse-grained cross-bedded limestone representing submarine banks which accummulated under strong current activity (Palmer, 1974). The overlying Caillasse de Fontaine-Henry is a horizontally bedded marly limestone, nodular in parts, containing comminuted shell debris and clay bands, deposited under much quieter conditions. These two units are lithologically very similar to the younger Calcaire de Blainville (Blainville Member) and the Caillasse de Blainville (Campagnettes Member) respectively. According to Rioult (1962, p. 55) the Caillasse de Fontaine-Henry has yielded ammonites characteristic of sediments younger than morrisi/subcontractus. The ostracods certainly agree with this as both the Calcaire de Blainville and the Calcaire de Reviers yield polonica Zone species and both the Caillasse de Blainville and the Caillasse de Fontaine-Henry yield blakeana Zone species. It is therefore concluded that the Calcaire de Reviers and the Caillasse de Fontaine-Henry are not valid as separate lithostratigraphic units but should be regarded as equivalent to the Calcaire de Blainville and the Caillasse de Blainville respectively.

The geographical area of the ostracod Zones presented here extends beyond the study area, at least in a northerly direction and is not only applicable to those areas in the immediate vicinity of the English Channel. It is anticipated that, with further research, the zonation will prove to be applicable over a much wider area. The Zones were originally erected for sediments in the Bath district, to the north of the Dorset Province. Previous work by Bate in central England has demonstrated the faunas and Zones to be the same here, although further north in Yorkshire the extensive deltaic facies, unsuitable for the development of the marine faunas, prevents correlation in this region. The northerly extent of the Zones is unknown as so little work has been done in this Boreal region. To the south, in France, the Zones appear to be applicable in the Lorraine area at least and even as far south as Provence the Bathonian has yielded species of Micropneumatocythere, Fastigatocythere and Eoschuleridea among brackish and freshwater species (Rohr, 1967) which would certainly repay closer investigation. To the east, through Germany and Poland the faunas are essentially the same as in the study area although it is unknown whether the zonal boundaries would represent precise time equivalents over such a wide region (the polonica Zone index, for example, has been cited as appearing in Poland within much older sediments than in southern England).

With further work a clearer idea would be gained as to the overrall areal extent of these Zones. Indeed, the correlation exercise here from a relatively small area, taken in association with the various published accounts of the surrounding regions, indicates that this zonation will hold true for a much wider area and be an alternative means of correlation to the ammonites which, it seems, will never achieve the status in the Bathonian that they hold elsewhere in the Jurassic.

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APPENDIX

Species lists are here given for all the Kent-Boulonnais Province sections and for all the Normandy sections (except the Port-en-Bessin section) in which ostracods were found; these are dealt with in the same order as in Chapter 4. For the Port-en-Bessin section and for the Dorset Province borehole sequences range-tables are given in the pocket. These are numbered as follows:

Table 1 Frome borehole
Table 2 Winterborne Kingston borehole
Table 3 Seabarn Farm borehole
Table 4 Lyme Bay boreholes
Table 5 Port-en-Bessin section

Southern England

Calvert

FOREST MARBLE - falcata Zone (102' - 113')

Konarocythere alpha gen. et sp. nov.
Schuleridea (Eoschuleridea) bathonica
S. (E.) trigonalis
S. (E.) sp.
Glyptocythere oscillum
G. penni
G. guembeliana
Micropneumatocythere falcata
M. quadrata
Fastigatocythere juglandica
Lophocythere fulgurata
L. batei
Progonocythere stilla
Terquemula septicostata
T. ? acutiplicata
Rectocythere sugillata
Dromacythere saggitata

Lesleya bathonica

Glabellacythere dolabra

Praeschuleridea subtrigona subtrigona

Bairdia hilda

Oligocythereis fullonica

O. ranvillensis sp. nov.

Eocytheridea sp.

Platycythere verriculata

Cytherelloidea catenulata

Monoceratina vulsa

Metacytheropteron drupaceum

Paracypris terraefullonicae

GREAT OOLITE - falcata Zone (137'3" - 139'3")

Ostracods recovered only from topmost beds.

Konarocythere alpha gen. et sp. nov.

Praeschuleridea subtrigona subtrigona

Micropneumatocythere falcata

Bythocypris ? sp.

Cytheropteron ? sp.

"HAMPEN MARLY BEDS" - blakeana Zone (155' - 157')

Glyptocythere oscillum

Praeschuleridea subtrigona subtrigona

Micropneumatocythere brendae

Fastigatocythere juglandica

Cytherella fullonica

Terquemula sp. indet.

Caytonidea ? sp.

Grove Hill

FOREST MARBLE - falcata Zone (2581' - 2666')

Micropneumatocythere falcata

Progonocythere stilla

Schuleridea (Eoschuleridea) trigonalis

S. (E.) bathonica

Eocytheridea sp.

'Cytheridea eminula' of Bate, 1969

Cytherella fullonica

Monoceratina visceralis

Parariscus bathonicus

Acanthocythere (A.) sphaerulata

UPPER FULLER'S EARTH - polonica Zone (2712' - 2743')

Ektyphocythere parva

Strictocythere polonica

Micropneumatocythere brendae

Palaeocytheridea carinilia

Praeschuleridea confossa

Progonocythere stilla

Schuleridea (Eoschuleridea) bathonica

Paracypris terrae fullonicae

Morkhovenicythereis bouvadensis

Procytherura ? sp.

Bobbing

FOREST MARBLE - falcata Zone (1110' - 1112')

Konarocythere alpha gen. et sp. nov.

Micropneumatocythere falcata

M. brendae

Fastigatocythere juglandica

Lophocythere ostreata

L. propinqua

Glyptocythere penni

G. guembeliana

G. persica

Schuleridea (Eoschuleridea) trigonalis

Praeschuleridea quadrata

Hekistocythere sp.

Platycythere verriculata

Parariscus bathonicus

Progonocythere stilla

Marslatourella sp.

GREAT OOLITE - ? blakeana Zone (1183' - 1185')

Top part of unit barren of ostracods.

Schuleridea (Eoschuleridea) bathonica

Terquemula ? acutiplicata

Praeschuleridea subtrigona subtrigona

Micropneumatocythere brendae

Chilham

LOWER CORNBRASH - falcata Zone (939')

Bairdia hilda

Praeschuleridea subtrigona subtrigona

FOREST MARBLE - falcata Zone (44'6" - 945')

Fastigatocythere juglandica

Glyptocythere guembeliana

Konarocythere alpha gen. et sp. nov.

Micropneumatocythere falcata

Lophocythere ostreata

Progonocythere stilla

Schuleridea (Eoschuleridea) trigonalis

GREAT OOLITE - blakeana Zone (987' - 1053')

Ostracods rare and badly preserved throughout entire unit.

Terquemula bradiana

Micropneumatocythere brendae

Hekistocythere sp.

'Cytheridea eminula' of Bate, 1969

Acanthocythere (A.) sphaerulata

Oligocythereis fullonica

Bairdia hilda

Brabourne

FOREST MARBLE - falcata Zone (1513' - 1518')

Konarocythere alpha gen. et sp. nov.

Micropneumatocythere falcata

Fossaterquemula blakeana

Lophocythere ostreata

Schuleridea (Eoschuleridea) bathonica

S. (E.) trigonalis

S. (E.) sp.

Praeschuleridea subtrigona subtrigona

Fastigatocythere juglandica

Glyptocythere oscillum

Glabellacythere dolabra

Bairdia hilda

Paracypris terraefullonicae

Cytherella fullonica

GREAT OOLITE - ? blakeana Zone

Depths and thicknesses unknown. Ostracods very rare and badly preserved throughout.

Acauthocythere sp. indet

Micropneumatocythere brendae

Fredville

LOWER CORNBRASH (1277')

Praeschuleridea subtrigona subtrigona

Acanthocythere (A.) spiniscutulata

Monoceratina vulsa

FOREST MARBLE - falcata Zone (1290' - 1293')

Micropneumatocythere falcata

M. quadrata

Schuleridea (Eoschuleridea) bathonica

Lophocythere ostreata

Nophrecythere rimosa

Fastigatocythere juglandica

Morkhovenicytheris bouvadensis

Acanthocythere sp.

Paracypris terraefullonicae

Pichottia muris

Gen. nov. sp.

Cytherelloidea catenulata

GREAT OOLITE - blakeana Zone (1303' - 1314')

Ostracods recovered from top of unit only.

Cytherelloidea jugosa

Micropneumatocythere brendae

M. subconcentrica

Palaeocytheridea carinilia

Paracypris terraefullonicae

Caytonidea ? sp.

Praeschuleridea subtrigona subtrigona

St. Margaret's Bay

LOWER CORNBRASH (basal part) - falcata Zone

Precise depths of samples not known.

Micropneumatocythere falcata

M. triangula sp. nov.

Fossaterquemula blakeana

Fastigatocythere juglandica

Lophocythere ostreata

L. propinqua

Progonocythere stilla

Glyptocythere oscillum

G. penni

Oligocythere ranvillensis sp. nov.

Protocythere micropapillata sp. nov.

Terquemula bradiana

Ektyphocythere parva

Schuleridea (Eoschuleridea) bathonica

Eocytheridea sp.

Glabellacythere dolabra

FOREST MARBLE - falcata Zone

Micropneumatocythere falcata

Fossaterquemula blakeana

Fastigatocythere juglandica

Lophocythere ostreata

L. fulgurata

Terquemula bradiana

Hekistocythere venosa

Progonocythere stilla

Glyptocythere oscillum

Marslatourella bullata

Cytherella fullonica

Cytherelloidea catenulata

C. jugosa

'Cytheridea eminula' of Bate, 1969

Aaleniella ? bathonica sp. nov.

Oligocythereis ranvillensis sp. nov.

Monoceratina vulsa

M. ? sp.

Glabellacythere dolabra

Acanthocythere (A.) spiniscutulata

Pichottia muris

Schuleridea (Eoschuleridea) bathonica

S. (E.) trigonalis

Praeschuleridea quadrata

Looneyella subtilis

Parariscus bathonicus

Paracypris terraefullonicae

GREAT OOLITE - falcata Zone

Ostracods recovered only from the topmost beds.

Konarocythere alpha gen. et sp. nov.

Micropneumatocythere triangula sp. nov.

Lophocythere ostreata

L. batei

Schuleridea (Eoschuleridea) bathonica

Praeschuleridea subtrigona subtrigona

Cytheropteron ? sp.

Dover no. 2.

Ostracods rare and badly preserved from the entire Bathonian section.

? CORNBRASH - falcata Zone (993' - 1001')

Terquemula ? acutiplicata

Hekistocythere venosa

Praeschuleridea subtrigona subtrigona

FOREST MARBLE - falcata Zone (1010' - 1020')

Glyptocythere oscillum

Micropneumatocythere falcata

GREAT OOLITE - ? blakeana Zone (1059' - 1080')

Micropneumatocythere brendae

M. triangula sp. nov.

Terquemula ? acutiplicata

Praeschuleridea subtrigona subtrigona

Normandy

Bayeux

A very disappointing Bajocian fauna from the Oolithe Blanche.

Bairdia hilda

Ljubimovella sp.

Polycope sp.

Cytherella fullonica

Indet. spp.

St. Aubin-sur-mer

ST. AUBIN MEMBER - falcata Zone

Cytherella fullonica

Cytherelloidea catenulata

C. longicosta sp. nov.

C. jugosa

Ptychobairdia limbata sp. nov.

Anchistrocheles ? spinosa sp. nov.

Bairdia hilda

Acanthocythere (A.) sphaerulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

'Cytheridea eminula' in Bate, 1969

Hekistocythere reticulata sp. nov.

H. tubulosa sp. nov.

Rectocythere sugillata

Palaeocytheridea carinilia

Micropneumatocythere falcata

Nophrecythere rimosa

Monoceratina tumida sp. nov.

Oligocythereis capreolata sp. nov.

Paracypris asymmetrica sp. nov.

Paracytheridea ? sp.

Polycope sp.

RANVILLE MEMBER - blakeana Zone

Bairdia hilda

Acanthocythere (A.) sphaerulata

Polycope sp.

Cliffs between Lion and Luc-sur-mer

LANGRUNE MEMBER - falcata Zone

Micropneumatocythere falcata

Praeschuleridea subtrigona subtrigona

Bairdia hilda

'Cytheridea eminula' in Bate, 1969

Morkhovenicythereis bouvadensis

Pleurocythere viriosa sp. nov.

Palaeocytheridea carinilia

Acanthocythere (Blanoacanthocythere) magna subgen. et. sp. nov.

Glabellacythere dolabra

Ljubimovella sp.

Oligocythereis ranvillensis sp. nov.

Nophrecythere rimosa

Hekistocythere reticulata

Cytherelloidea catenulata

C. jugosa

Monoceratina tumida sp. nov.

M. sp.

Ektyphocythere parva

Rutlandella enigmatica sp. nov.

ST. AUBIN MEMBER - falcata Zone.

Bairdia hilda

Cytherella fullonica

Acanthocythere (A.) spiniscutulata

Oligocythereis ranvillensis sp. nov.

Bènouville

ST. AUBIN MEMBER - falcata Zone

Micropneumatocythere falcata

Cytherella fullonica

Cytherelloidea longicostata sp. nov.

C. jugosa

C. bractea sp. nov.

'Cytheridea eminula' of Bate, 1969

Glabellacythere dolabra

Fossaterquemula blakeana

Palaeocytheridea carinilia

Nophrecythere rimosa

Monoceratina vulsa

Oligocythereis ranvillensis sp. nov.

Bairdia hilda

Acanthocythere (A.) spiniscutulata

Schuleridea (Eoschuleridea) bathonica

RANVILLE MEMBER - falcata Zone

'Cytheridea eminula' of Bate, 1969

Bairdia hilda

Acanthocythere (A.) spiniscutulata

Oligocythereis ranvillensis sp. nov.

Monoceratina vulsa

Cytherella fullonica

Cytherelloidea bractea sp. nov.

Longueville

LANGRUNE MEMBER - falcata Zone

Acanthocythere (A.) sphaerulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

Bairdia hilda

'Cytheridea eminula' of Bate, 1969

Cytherella fullonica

Amfrèville

LANGRUNE MEMBER - falcata Zone

Bairdia hilda

Glabellacythere dolabra

Cytherella fullonica

'Cytheridea eminula' of Bate, 1969

ST. AUBIN MEMBER - falcata Zone

Bairdia hilda

Glabellacythere dolabra

Cytherella fullonica

Cytherelloidea catenulata

'Cytheridea eminula' of Bate, 1969

Acanthocythere (A.) sphaerulata

A. (A.) spiniscutulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

Fossaterquemula blakeana

Palaeocytheridea carinilia

Nophrecythere rimosa

Ptychobairdia limbata sp. nov.

Monoceratina sp.

Schuleridea (Eoschuleridea) bathonica

Oligocythereis ranvillensis sp. nov.

RANVILLE MEMBER - blakeana Zone

Acanthocythere (A.) sphaerulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

'Cytheridea eminula' of Bate, 1969

Bairdia hilda

Fontaine-Henry

CAMPAGNETTES MEMBER - blakeana Zone

Cytherella fullonica

Cytherelloidea catenulata

'Cytheridea eminula' in Bate, 1969

Schuleridea (Eoschuleridea) bathonica

Bairdia hilda

Paracypris sp.

BLAINVILLE MEMBER - polonica Zone

Acanthocythere (A.) sphaerulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

'Cytheridea eminula' in Bate, 1969

Bairdia hilda

Douvres-la-Delivrande

LANGRUNE MEMBER - falcata Zone

Bairdia hilda

Acanthocythere (A.) sphaerulata

A. (A.) spiniscutulata

'Cytheridea eminula' in Bate, 1969

Cytherella fullonica

Cytherelloidea catenulata

C. longicostata sp. nov.

Terquemula bradiana

Bythocypris ? sp.

Reviers

ST. AUBIN MEMBER - falcata Zone

Bairdia hilda

Acanthocythere (A.) sphaerulata

A. (A.) spiniscutulata

Cytherella fullonica

C. symmetrica

Cytherelloidea bractea sp. nov.

C. longicostata sp. nov.

'Cytheridea eminula' in Bate, 1969

Fossaterquemula blakeana

Schuleridea (Eoschuleridea) bathonica

Pleurocythere viriosa

Palaeocytheridea carinilia

Monoceratina tumida sp. nov.

Ptychobairdia limbata sp. nov.

Mandocythere primaeva sp. nov

Limnocythere sp.

Nophrecythere rimosa

Oligocythereis fullonica

Rutlandella enigmatica

Hekistocythere anastomosis

Paracytheridea ? sp.

Ljubimovella ? sp.

Pontocyprella sp.

Polycope sp.

RANVILLE MEMBER - blakeana Zone

Acanthocythere (A.) sphaerulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

Cytherella fullonica

Cytherelloidea longicostata sp. nov.

Bairdia hilda

'Cytheridea eminula' in Bate, 1969

Nophrecythere rimosa

Morkhovenicythereis bouvadensis

Schuleridea (Eoschuleridea) bathonica

Pierrepont

BLAINVILLE MEMBER - polonica Zone

A disappointing fauna from this cross-bedded limestone sequence.

Bairdia hilda

Schuleridea (Eoschuleridea) trigonalis

Acanthocythere (Blanoacanthocythere) subgen. et sp. nov.

Ranville - Cement Works

RANVILLE MEMBER - blakeana Zone

Bairdia hilda

Cytherella fullonica

Nophrecythere rimosa

'Cytheridea eminula' in Bate, 1969

Acanthocythere (A.) spiniscutulata

CAMPAGNETTES MEMBER - blakeana Zone

Acanthocythere (A.) sphaerulata

A. (A.) spiniscutulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

Fossaterquemula blakeana

Oligocythereis ranvillensis sp. nov.

Cytherella fullonica

Cytherelloidea jugosa

C. catenulata

C. longicostata sp. nov.

Bairdia hilda

Nophrecythere rimosa

Pleurocythere viriosa sp. nov.

Micropneumatocythere subconcentrica

Palaeocytheridea carinilia

'Cytheridea eminula' in Bate, 1969

Paracypris asymmetrica sp. nov.

Terquemula bradiana

Schuleridea (Eoschuleridea) bathonica

Rutlandella enigmatica sp. nov.

BLAINVILLE MEMBER - polonica Zone

Bairdia hilda

Ranville - Carrière des Campagnettes

ST. AUBIN MEMBER - falcata Zone

Bairdia hilda

Cytherella fullonica

Cytherelloidea jugosa

Acanthocythere (A.) sphaerulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

'Cytheridea eminula' in Bate, 1969

RANVILLE MEMBER - blakeana Zone

Bairdia hilda

Cytherella fullonica

Acanthocythere (A.) sphaerulata

'Cytheridea eminula' in Bate, 1969

CAMPAGNETTES MEMBER - blakeana Zone

Bairdia hilda

Acanthocythere (A.) sphaerulata

A. (A.) spiniscutulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

Cytherella fullonica

Cytherelloidea longicostata sp. nov.

C. catenulata

C. jugosa

'Cytheridea eminula' in Bate, 1969

Micropneumatocythere brendae

Genus B of Bate, 1979

Ptychobairdia limbata sp. nov.

Nophrecythere rimosa

Mandocythere primaeva sp. nov.

Rutlandella enigmatica sp. nov.

Oligocythereis ranvillensis sp. nov.

Schuleridea (Eoschuleridea) bathonica

BLAINVILLE MEMBER - polonica Zone

Acanthocythere (A.) sphaerulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

Bairdia hilda

Cytherella fullonica

Cytherelloidea longicostata sp. nov.

'Cytheridea eminula' in Bate, 1969

Ptychobairdia limbata sp. nov.

Nophrecythere rimosa

Monoceratina tumida sp. nov.

Rutlandella enigmatica sp. nov.

Cintheaux

CALCAIRE DE CAEN

A very disappointing fauna was obtained from this M. Bathonian limestone.

Bairdia hilda

'Cytheridea eminula' in Bate, 1969

Praeschuleridea subtrigona subtrigona

Monoceratina sp.

Occagnes

LANGRUNE MEMBER - falcata Zone

Acanthocythere (A.) sphaerulata

A. (A.) spiniscutulata

A. (Blanoacanthocythere) magna subgen. et sp. nov.

Micropneumatocythere falcata

Cytherella fullonica

Cytherelloidea longicostata sp. nov.

Terquemula bradiana

Ektyphocythere parva

Praeschuleridea subtrigona subtrigona

Schuleridea (Eoschuleridea) bathonica

Morkhovenicythereis bouvadensis

'Cytheridea eminula' in Bate, 1969

Nophrecythere rimosa

Bairdia hilda

Glabellacythere dolabra

Bythocypris ? sp.

Aubry-en-Exmes

LANGRUNE MEMBER - falcata Zone

Bairdia hilda

Morkhovenicythereis bouvadensis

Acanthocythere (A.) sp.

Boulonnais

"Les Pichottes" Quarry, Boulongne

FOREST MARBLE EQUIVALENT - falcata Zone

Schuleridea (Eoschuleridea) bathonica

S. (E) trigonalis

Praeschuleridea quadrata

Fossaterquemula blakeana

Hekistocythere venosa

Fastigatocythere juglandica

Micropneumatocythere falcata

M. quadrata

M. subconcentrica

Glyptocythere oscillum

Lophocythere ostreata

L. propinqua

L. fulgurata

Terquemula bradiana

Progonocythere stilla

Palaeocytheridea carinilia

Looneyella subtilis

Cytherella fullonica

Cytherelloidea catenulata

Metacytheropteron drupaceum

Oligocythereis ranvillensis sp. nov.

O fullonica

Paracypris terraefullonicae

Parariscus bathonicus

Citrella nitida

Marslatourella bullata

Ektyphocythere parva

Aaleniella ? bathonica sp. nov.

Pichottia muris

Monoceratina vulsa

M. tumida sp. nov.

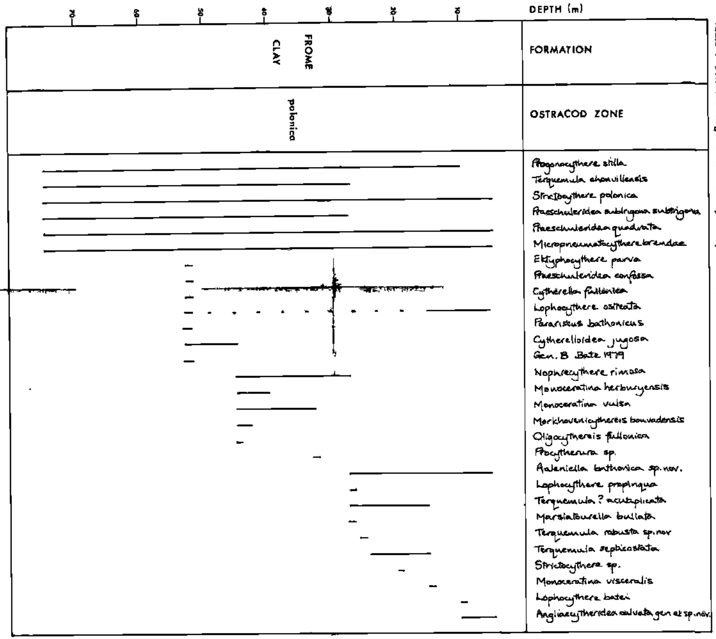

Table 4 Ostracod range table for the Lyme Bay borehole 79/33

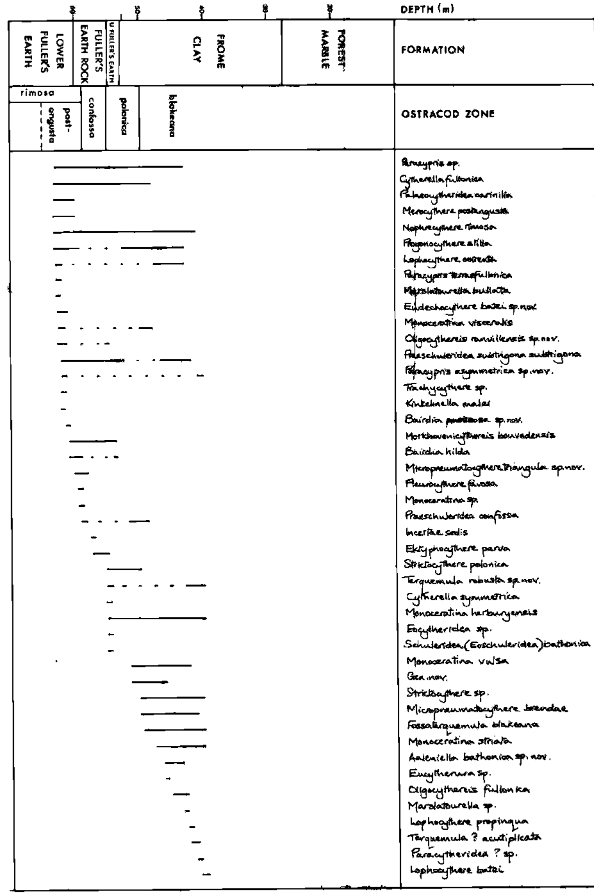

Table 1 Ostracod range table for the Frome borehole

Table 2 Ostracod range table for the Winterborne Kingston borehole

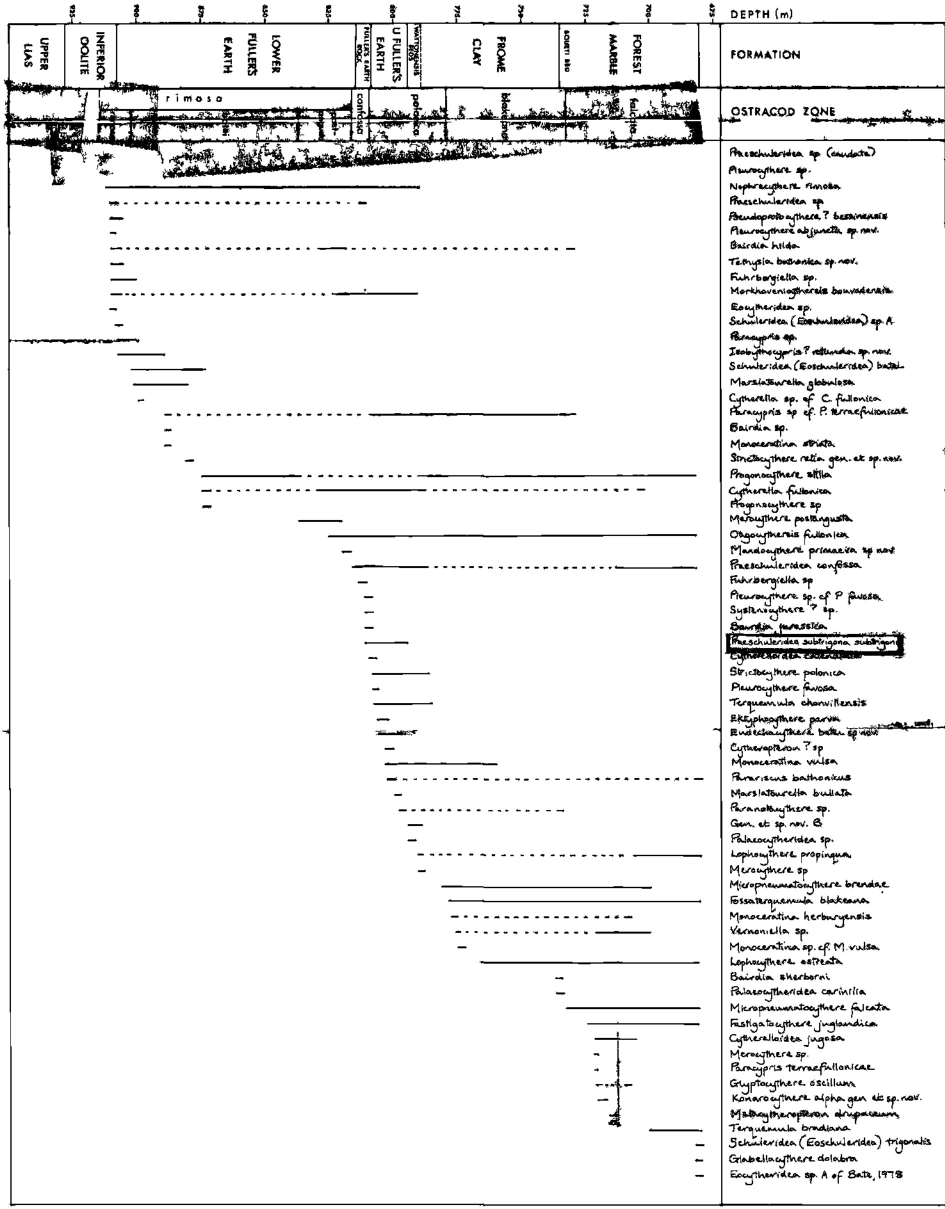

Table 3 Ostracod range table for the Seabarn Farm borehole

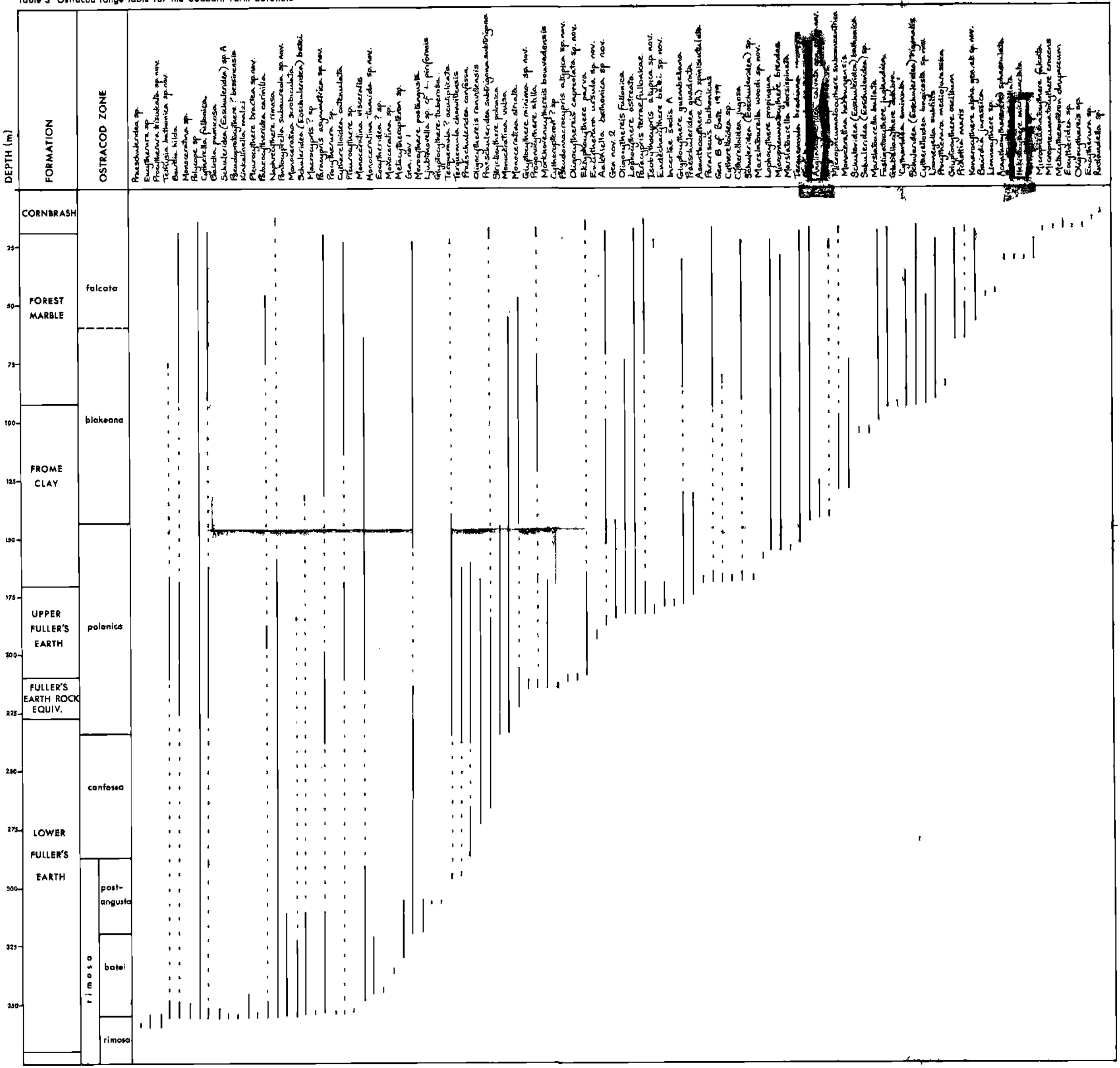

Table 5 Ostracod range table for the Port-en-Bessin section